the examination series

examination EMERGENCY MEDICINE

A GUIDE TO THE ACEM FELLOWSHIP EXAMINATION

Garry Wilkes, Bronwyn Peirce, Carole Foot and Joseph Ting

CHURCHILL LIVINGSTONE
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Dedicated to

Paige Peters
Michael Harwood
Tom Czarniecki
Bruce Parr

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Foreword

Few emergency medicine trainees look forward to sitting for the written component of their fellowship examination for the Australasian College for Emergency Medicine, and even when invited on to undertake the clinical component most approach the exam with a mixture of dread and foreboding. So much hangs on success, with little, if any, solace in failing.

Most candidates are already functioning at the highest level as integral members of middle-grade staff at some of Australia and New Zealand's busiest emergency departments, and clearly have abundant knowledge and skills. What sets successful candidates apart is good exam preparation, which means preparation in those same modalities that are tested in the fellowship exam. What better way to learn this than from a book focused on those very modalities, written by experienced emergency physicians with a particular interest in education and training, who have dissected every aspect of the fellowship exam.

This brilliant text covers general aspects about preparing for the fellowship examination, followed by information on the individual written and clinical components. It includes sample questions and template answers for the written sections, hints on how to approach the clinical component and, more importantly, how candidates can convey their findings to the examiners with maximum finesse and panache. Finally, there is discussion on the publication/presentation requirement that now needs to be completed prior to sitting for the fellowship, including analysis and interpretation of the quality of medical literature, with some key examples of useful papers.

Candidates should use this book regularly as they endlessly practise for the examination. The book will also be invaluable to emergency physicians who teach those candidates, and to the Directors of Emergency Medicine Training who orchestrate the whole process. In addition, the book is valuable for emergency department doctors, as it is actually a fine overview of clinical reasoning, clinical examination technique (especially the neurological examination, which is covered in great detail, as it is technically one of the hardest parts of the long and short cases) and how to expertly refer a case to a colleague.

I commend the authors on a difficult job well done, and recommend this book for fellowship candidates to reduce their tension and increase their chances of an exhilarating performance on the day, demonstrating with flair those skills they already have in abundance.

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Preface

> There is nothing training cannot do. Nothing is above its reach. It can turn bad morals to good; it can destroy bad principles and recreate good ones; it can lift men to angelship.
>
> *Mark Twain*

Congratulations! By reading this you have declared yourself ready to commence, or at least be interested in, preparation for the Australasian College for Emergency Medicine (ACEM) fellowship examination. This is a journey the authors have taken along with many others. ACEM was incorporated in 1984 and the first primary examination was held later that year. The first fellowship examination was held in 1986 with a total of eight successful candidates. Much has changed since that time. The examination has become more organised and structured, with increased transparency of process and content.

The report from the Chair of the Fellowship Examination Committee (FEC) following each examination is posted on the 'Members' section of the College website (**www.acem.org.au**) and is accessible to all examination candidates, examiners, FEC members and Directors of Emergency Medicine Training (DEMTs), as well as others involved in individual examinations. The report outlines the percentage pass rate for each section, and offers feedback regarding performance on each individual question. Areas of poor performance can therefore be used to identify weaknesses in candidate knowledge and abilities, and guide future preparation.

The single most important thing to remember when you are preparing for the fellowship examination is that you are not just preparing for the examination — you are more importantly preparing to become a competent specialist in emergency medicine. Each aspect of the examination process showcases various facets of what 'makes' an emergency physician. As such, the oft-quoted saying, 'The exam is just like a day at work', is completely true. However, the biggest difference between the examination and a day at work is that during the examination *every* clinical case offers something to find and talk about with well-informed colleagues who are eager and waiting to have a specialist-level discussion with you. Fortunately, the bells terminating these discussions merely serve to move you on to the next case, not to a MET or an arrest call! Viewed another way, you are unlikely to come across such depth and breadth of clinical material in any other day and a half of your life!

There is no universally agreed process for preparing for the fellowship examination. Each region and even each DEMT develops something that works for them. By and large, the most successful programs have resulted from skilled, inspiring individuals who usually produce a 'hot spot' of success that then spawns further mentors who teach the next generation and so on. The authors of this book originally met in such a 'hot spot' in Brisbane in the 1990s, and have continued involvement in many aspects of education and training throughout Australasia and overseas. This book has been

developed with the hope of passing on some of this shared experience. It details the components of the fellowship examination and provides suggestions for preparation both generally and specifically for individual components. Additional information that we believe will assist you in your endeavour is also provided.

We wish you well in your journey and look forward to meeting you as future colleagues.

Garry Wilkes
Bronwyn Peirce
Carole Foot
Joseph Ting
June 2009

How to use this book

This book is a guide: it is intended to *supplement*, not substitute for, material available from ACEM, particularly on the College website. We strongly encourage you to consult this material regarding any recent changes to the examination processes, as it is updated regularly. Although the examination process has had a relatively static structure over the last few years, it is constantly evolving and minor but important changes to the preferred nature and format of question types have occurred over time. A shift towards using photographs that show clinical problems rather than equipment or therapies in the VAQ section illustrates this point.

In addition, this book is not a substitute for being part of a DEMT-led training program. It does not provide all the answers, it does not replace other reading material and it is not intended to turn you into an 'examination candidate clone'.

We recognise that there are a number of ways to approach the fellowship examination, and that there are many successful mentors and DEMTs who can assist you in that process. This book has arisen from our shared experiences preparing for and preparing others for the examination and it contains information we have found useful and successful over a combined period of decades of teaching and training. It offers one way, not the only way.

Chapter 1 provides general information relating to various aspects of preparation, with specific comments on each section of the examination itself. We also address components of preparation important to your own wellbeing.

Chapters 2–7 are devoted to individual components of the examination. We cover what is expected from each component, how to prepare for the components in general terms, the specific details of the format of the examination itself and suggestions for approaches on the day. We also provide tables of 'likely' or expected content and worked sample questions. This should not be considered a comprehensive list of all cases and questions that could be asked in the examination. Indeed, some examiners may view parts of our list of investigations to be beyond the realms of what should be arranged in the emergency department, but this simply reflects the slight variations in real-life practice. Recognising that the specialty encompasses anything that might come through the door, these sections are guides for your study, ensuring that you cover the entire curriculum. Everything is 'fair game', so be prepared for the unexpected — just as you need to be at work!

Likewise, where sample answers are provided, we do not claim that these are 'model' answers. Individual examiners have different expectations and marking styles. Don't worry if your answers are less detailed than those provided here: we are aiming to give you an idea of the depth and breadth of what could be included when answering questions. Adding extra information if time permits may bring you extra marks, but this should not be done at the detriment of answering other questions.

Chapter 8 is devoted to the publication/presentation requirement of fellowship. The majority of trainees must now complete this requirement in order to be eligible to sit the fellowship examination. For those who registered earlier, this must be achieved

within three years of passing the examination or you will need to resit the examination. With prior planning, this requirement can be satisfied early, removing an unnecessary burden. We include this section particularly for trainees who have left this component until late in their training, to facilitate their movement towards and beyond the fellowship 'exit' examination.

Finally, Chapter 9 comprises supplementary material that our trainees have found helpful or have frequently asked us for direction in locating. We have included a brief summary of information about evidence-based medicine because we feel fellowship candidates should possess the basic tools that will assist them in their quest to assimilate the important knowledge that is a prerequisite to approaching the examination components. We have also selected summaries of many journal articles, based on our perceptions of what is important. It should be recognised that, given the breadth of knowledge that influences emergency medicine, this compilation cannot be exhaustive. The quality of evidence provided is also highly variable and you are encouraged to critique these offerings as well as to add to this list as your reading progresses.

Although the book is arranged in the order of the examination components, we do not intend you to read it only from front to back. Feel free to flick from one section to another depending on your preference. Your aim is to get to the other side of the examination: it doesn't matter what path you take to get there. Chapters 8 and 9 in particular are provided as supplementary resources that ideally will assist you in the early stages of your preparation, but can also be used later in the process to stimulate revision and additional exploration of the literature. Our ultimate aim is to provide a framework and tools that will make your journey a little less daunting.

About the authors

Associate Professor **Garry Wilkes** is an enthusiastic clinician and educator. Since winning the Buchanan Prize in the ACEM fellowship examination, he has been DEMT and assisted trainees in Western Australia, Queensland and Tasmania in tertiary, peripheral and rural EDs. Garry entered the Court of Examiners in 1998 and has served on a number of ACEM committees, most recently the Standards Committee and as Chair of the Prehospital Care Subcommittee. He is Director of Emergency Medicine in Bunbury, Western Australia, and Medical Director of St John Ambulance, Western Australian Ambulance Service. His academic affiliations are with the Rural Clinical School, University of Western Australia, and Edith Cowan University. Garry is a Course Director and Committee Member for RACS for both CCrISP (ACEM rep) and EMST (WA rep), and can be spotted regularly around Australia and the South Pacific on courses. In his spare time, Garry engrosses himself in his hobbies of astronomy and quantum mechanics.

Associate Professor **Bronwyn Peirce** found inspiration for teaching at least in part from her mother and currently works as a Medical Educator with the Rural Clinical School, University of Western Australia, and as a Senior Staff Specialist in Emergency Medicine at Bunbury Regional Hospital, Western Australia. Since training and working in many Queensland hospitals, Bronwyn has been working her way anticlockwise around Australia. During this time, she has been DEMT at Royal Darwin and Bunbury Regional Hospitals. Bronwyn is a member of the ACEM Primary Examination Committee, the Fellowship Examination Visual Answer Question Subcommittee and the Rural and Regional Committee. When not working, she enjoys time with her family, good food, bushwalking, singing and belly-dancing.

Dr **Carole Foot** has dual fellowships in Emergency Medicine and Intensive Care Medicine. Her enthusiasm for teaching, medical simulation and practising critical care has taken her all over the world. She is currently a Staff Specialist in Intensive Care at Royal North Shore Hospital, Sydney, and a Visiting Specialist at North Shore Private Hospital, Sydney. Her professional interests include modern educational methods, leadership and management training. A keen enthusiasm for quality holidays, movies, and good wine and food keeps her balanced.

Dr **Joseph Ting** is an emergency physician based at the Mater Public Hospitals in Brisbane. He has assisted with 'fine-tuning' Brisbane-based fellowship candidates since 2001. He is a member of the Fellowship Examination Structured Clinical Examination Subcommittee and co-organised the 2006.1 fellowship examination in Brisbane. He is currently DEMT at the Mater Adult Hospital in Brisbane. Joseph's clinical interests include clinical and observational trials, health systems research, and retrieval and expedition medicine. He is the inaugural Frank Garlick Fellow of the Queensland Emergency Medicine Research Foundation.

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The authors have taken considerable care to ensure the accuracy of the information contained in this book at the time of writing. However, errors are inevitable in manuscripts of this size and some factors are subject to change. The reader is advised to check all information carefully before using it in clinical practice. The authors take no responsibility for any errors that may be contained herein, or for any misfortune befalling any individual as the result of action taken using information in this book.

Abbreviations

AAA	abdominal aortic aneurysm
ABC	Airway, Breathing, Circulation (usually in reference to assessing and treating immediate life threats during resuscitation)
ABCDE	Airway, Breathing, Circulation, Disability, Exposure/Environment control (together comprising the 'primary survey')
ABG	arterial blood gases
ACE	angiotensin converting enzyme (inhibitor)
ACEM	Australasian College for Emergency Medicine
ACLS	advanced cardiac life support (course)
ACME	advanced complex medical emergencies (course)
AF	atrial fibrillation
AI	aortic valve incompetence/insufficiency
ALK PHOS	alkaline phosphate
ALS	advanced life support
ALT	alanine transaminase
AMI	acute myocardial infarction
AMPLE	Allergies, Medications, Past history, Last ate/drank, Events (together comprising a focused history, particularly in the setting of trauma)
ANA	anti-nuclear antibody
APLS	advanced paediatric life support (course)
aPTT	activated partial thromboplastin time
ARC	Australian Resuscitation Council
ARDS	acute respiratory distress syndrome
ASD	atrial septal defect
AST	aspartate aminotransferase
ATLS	advanced trauma life support (RACS course = EMST)
ATS	Australasian triage scale (score)
BLS	basic life support
BP	blood pressure
BR	bilirubin
BSL/BGL	blood sugar/glucose level
CAL	chronic airway limitation (see COAD/COPD)
CAPD	continuous ambulatory peritoneal dialysis
CBR	Chemical, Biological, Radiation (specific hazards in emergency preparedness)
CCF/CHF	congestive cardiac (heart) failure
CCrISP	care of the critically ill surgical patient (RACS course)
CEO	chief executive officer
CIC	Censor-in-Chief
CK	creatinine kinase (test)
CMV	cytomegalovirus
CNS	central nervous system
COAD/COPD	chronic obstructive airways (pulmonary) disease (see CAL)
CPR	cardiopulmonary resuscitation
CSF	cerebrospinal fluid

CT KUB	CT scan of Kidneys, Ureters and Bladder
CVA	cerebro-vascular accident (neurological deficit persisting > one week)
CVL/CVC	central venous line (catheter)
CVP	central venous pressure
DEM	Department of Emergency Medicine
DEMT	Director of Emergency Medicine Training
DIC	disseminated intravascular coagulation
DIP	distal interphalangeal (joint)
DKA	diabetic ketoacidosis
DNR	do not resuscitate (status/order); see NFR
DPL	diagnostic peritoneal lavage
dsDNA	double-stranded deoxyribonucleic acid (test)
DVT	deep venous thrombosis
EAR	expired air resuscitation
EBM	evidence-based medicine
EBV	Epstein-Barr virus
ECC	external cardiac compressions
ECG	electrocardiograph
ED	Emergency Department
EEG	electroencephalography
EMD	electro-mechanical dissociation (see PEA)
EMSB	early management of severe burns (course)
EMST	early management of severe trauma (RACS course = ATLS)
ETT	endotracheal tube
FACEM	Fellow of the Australasian College for Emergency Medicine
FBC	full blood count
FDP	fibrin degredation products
FEC	Fellowship Examination Committee
FFP	fresh frozen plasma
FTE	full-time equivalent (staffing numbers)
GCS	Glasgow coma scale (score)
G-CSF	granulocyte colony stimulating factor
GGT	gamma glutamyl transpeptidase
GI/GIT	gastrointestinal (tract)
GP	general practitioner
HCG	human chorionic gonadotrophin (used as pregnancy test)
HDU	high-dependency unit
HHS	hyperosmolar hyperglycaemic state (see HONK)
HIV	human immunodeficiency virus
HOCM	hypertrophic obstructive cardiomyopathy
HONK	hyperosmolar non-ketotic coma (see HHS)
HR	heart rate
HSP	Henoch-Schönlein purpura
HSV	herpes simplex virus
HUS	haemolytic-uraemic syndrome
ICC	intercostal catheter
ICD	implanted cardiac defibrillator
ICEM	International College of Emergency Medicine
ICU/ITU	intensive care (therapy) unit
IDC	indwelling drainage catheter (urine)
IHD	ischaemic heart disease
ILCOR	International Liaison Committee on Resuscitation
IM	intramuscular (injection)

ITP	idiopathic thrombocytopaenic purpura
IV	intravenous
IVC	inferior vena cava
IVP	intravenous pyelogram
JVP	jugular venous pressure
LAH	left anterior hemiblock (pattern on ECG)
LBBB	left bundle branch block (pattern on ECG)
LDH	lactic dehydrogenase (test)
LFTs	liver function tests
LMA	laryngeal mask airway
LOC	loss of consciousness; also (reduced) level of consciousness
LP	lumbar puncture
MAP	mean arterial pressure
m/c/s	microscopy/culture/antibiotic sensitivity
MCQ	multiple-choice question
MCP	metacarpophalangeal
MCV	mean corpuscular volume
MH	malignant hyperthermia
MRI	magnetic resonance imaging
NFR	not for resuscitation (status/order); see DNR
NGT	nasogastric tube
NIBP	non-invasive blood pressure
NMS	neurolept malignant syndrome
NOF	neck of femur (fracture)
non-STEMI	non-ST elevation myocardial infarction
NSAID	non-steroidal anti-inflammatory drug
OGT	orogastric tube
P	pulse (rate)
PA	posterior-anterior (usually referring to beam direction of X-ray)
PAD	public access defibrillation
PAT	paraxoysmal atrial tachycardia
PCIA	patient-controlled infusion analgesia (device)
PCR	patient care record
PE	pulmonary embolism
PEA	pulseless electrical activity (see EMD)
PEC	Primary Examination Committee
PEG	percutaneous enterogastrostomy (tube)
PEEP	positive end expiratory pressure
PIP	proximal interphalangeal (joint)
PO	per oral (by mouth)
PPH	post partum haemorrhage
PPI	proton pump inhibitor (drug)
PR	per rectal (examination)
PT	prothrombin time
PV	per vaginal (examination)
QRS	combination of Q, R and S waves on ECG (principle complex)
RACP	Royal Australian College of Physicians
RACS	Royal Australasian College of Surgeons
RBBB	right bundle branch block (pattern on ECG)
RBS(B)	red-back spider (bite)
RCT	randomised clinical trial
RIND	reversible ischaemic neurological deficit (duration 24 hours – one week)

RR	respiratory rate
R_x	therapy or treatment (derived from 'recipe')
SaO_2	arterial oxygen saturation (percentage)
SAQ	short-answer question
SCE	structured clinical examination
$ScvO_2$	central venous oxygen saturation (percentage)
SIRS	systemic inflammatory response syndrome
SLE	systemic lupus erythematosis
STEMI	ST elevation myocardial infarction
SVC	superior vena cava
SVT	supraventricular tachycardia
T	temperature
TIA	transient ischaemic attack (duration < 24 hours)
TTP	thrombotic thrombocytopaenic purpura
U&E	urea and electrolytes (test)
URTI	upper respiratory tract infection
US	ultrasound
UTI	urinary tract infection
VAQ	visual-aid question
VDK	venom detection kit (snake bite)
VEBs	ventricular ectopic beats
VF	ventricular fibrillation
VIPs	very important persons
VSD	ventricular septal defect
VT	ventricular tachycardia
WCC	white cell count (test)

Chapter 1

Preparing for the fellowship examination

> If you study to remember, you will forget; but,
> if you study to understand, you will remember.
>
> *Unknown*

Fellowship training requirements

Details of eligibility to sit the fellowship examination and other training requirements are listed in the *Training and Examination Handbook* (available via the ACEM Secretariat) with which all trainees should be familiar. Regulation 4.14 deals with the requirements of the fellowship examination. For the majority of trainees, eligibility to sit the fellowship examination is dependent on being in the final year of training and having satisfied the publication/presentation requirement.

The examination is 'criterion referenced' rather than 'norm referenced', which means that all candidates who meet the criteria will pass, and only those candidates will pass. It also means that 100% or 0% can pass a particular examination, depending on individual performance. The pass criteria are those expected of a competent emergency medicine specialist. In simple terms, this means that you will pass if you can satisfy the examiners that you can work safely and independently at the level of a consultant.

The format of the fellowship examination

> I find the thing in this world is not so much
> where we stand as in what direction we are
> moving.
>
> *Oliver Wendell Holmes*

The fellowship examination is currently held twice a year. The exam is divided into two components, written and clinical, and the written component is scheduled approximately two months prior to the clinical component. Only those candidates who pass following marking of the written component will be invited to participate in the clinical component. Candidates who are unsuccessful in the written component are notified by mail at the same time as other candidates receive their invitation to the clinical component.

At all times during the examination you are identified only as a number: names are not used. The initial digits indicate the number of the examination and subsequent digits are assigned in a manner so as not to identify candidates in any way. For

example, the second examination in 2008 was the 42nd fellowship examination, so candidate numbers ranged from 4201 upwards. For the clinical components, you will be provided with a sticker to wear with your number on it. A marking scale out of 10 is used throughout the examination. A score of five constitutes a pass.

Written component

Written components are conducted in each region (with a maximum of two centres in each region). There are three parts to the written component, conducted in a single day:

- **Part A: multiple-choice questions (MCQs).** The format is 60 type 'A' questions (that is, only one choice out of five options) over 90 minutes (about one and a half minutes per question). There is no negative marking, so ensure that you answer every question. Marks are adjusted to account for the fact that candidates should answer 20% of questions correctly by random chance. Hence, answering fewer than 20% of questions correctly results in a score of zero: candidates need to answer 33 questions correctly (55%) to pass — other scores are graded accordingly (see Table 1.1).
- **Part B: short-answer questions (SAQs).** The format is eight questions over two hours (about 15 minutes per question). This section focuses on assessment, interpretation, prioritisation and management issues in terms of written communication at the consultant level. Some questions may contain subsections, in which case the percentage assigned to each will be specified. Each of the eight questions is marked out of 10. To pass this section overall candidates must obtain a pass (that is, score five or more) for at least five questions *and* have a total score of 40 or more (see Table 1.1).
- **Part C: visual-aid questions (VAQs).** The format is eight questions over one hour (about seven and a half minutes per question). Questions are arranged in the form of a background statement and a visual 'prop'. A broad range of investigations and clinical material may be used. VAQs assess the candidate's competence at recognising and interpreting data, as well as decision making. Up to three questions are drawn from the background statement and 'prop'. There may be a second 'prop' depending on the particular question. Where there is more than one subsection, the percentage assigned to each question will be specified. Each of the eight questions is marked out of 10, with the same overall marking scale employed as for the SAQ section (see Table 1.1).

The MCQs are marked by computer, while the SAQs and VAQs are each marked by two examiners in turn. The examiners are blinded to each other's scores until they discuss their marks and agree on the final mark to be submitted. As a result, there is a delay of approximately four weeks until the final marks are allocated.

To pass the examination overall, candidates must pass at least two of the three written parts. Candidates who fail more than one written part will not be invited to participate in the clinical component.

Clinical component

The three parts of the clinical component are conducted over two days. This is typically held on a Saturday and Sunday in an outpatient/clinic facility, but may vary. Usually the long and short cases are spread over two sites, with candidates and examiners spending the whole day at one site, whereas the structured clinical examination (SCE) is held at a single venue. The current format of the examination has the long case on the first morning, the short cases in the afternoon and the SCE on the second day.

Long case

Each candidate sees a single long case. You have 35 minutes with the patient, five minutes for consolidation and preparation, and then 20 minutes with a pair of examiners. An agreed mark out of 10 is assigned. If you are allocated to the first portion of the long case section, you will be quarantined until the remaining candidates have finished.

Short cases

Each candidate sees a total of four short cases — two cases with one pair of examiners and another two cases with a different pair of examiners — with the expectation that at least one of these cases will involve a child. Each of the four examiners will act as the lead for an individual case. Twenty minutes is assigned to each pair of cases, which is roughly to be split between the two cases. After the first 20 minutes on two cases, you will be escorted to a different location (often next door or across the corridor). When the bell is rung five minutes later, you have the second 20 minutes with the second pair of cases and examiners. The examiners award a score out of 10 for each individual short case, and these scores are then consolidated to derive an overall score out of 10. To achieve an overall pass, candidates must pass at least two of the four cases. Consistency is rewarded more than good performance on individual cases (see Table 1.1).

Structured clinical examination (SCE)

The final section of the fellowship examination consists of the SCE with six stations. The usual format is like musical chairs in six adjacent rooms (except in this game everyone gets a seat!). Outside each room is a brief 'prompt' such as a brief clinical scenario. For each station, you are allocated three minutes to get to the station and review the 'prompt', and seven minutes to spend with a pair of examiners, one of whom will act as lead while the other scribes. Candidates should expect that one station will focus on a difficult communication or administration scenario with an actor involved. Each of the six stations is marked out of 10: to achieve an overall pass, candidates must pass at least four stations *and* attain a total score of 30 or more. Once again, consistency is rewarded more than good performance at individual stations. Five or more stations must be passed to pass the section overall (see Table 1.1).

Additional clinical cases

Because the clinical component involves real patients, on rare occasions a situation may occur where for the wellbeing of the patient a short or long case has to be terminated prematurely. If this occurs, the Censor-in-Chief or Chair of the Fellowship Examination Committee (FEC) will determine whether the candidate must see an extra case. 'Spare' cases (and examiners) are prepared for this eventuality. Usually the supplementary case can be seen immediately, but may be at the end of the session depending on individual circumstances. Additional clinical cases are not awarded simply to give borderline candidates another 'chance'.

Overall result

Details of the marking schedule are provided in Table 1.1. A final possible score of 60 is obtained from the score out of 10 from each of the six sections. To pass overall, you must:

- score a total of 30 or more with a pass in all six sections, *or*
- score a total of 31 or more with a pass in five sections, *or*
- score a total of 32 or more with a pass in at least two written *and* two clinical sections.

TABLE 1.1 The fellowship examination marking schedule

1. Written component
Part A: MCQs: 60 type 'A' questions

Score	Number of correct questions required to obtain grade
1	≥ 17
2	≥ 21
3	≥ 25
4	≥ 29
5	≥ 33
6	≥ 37
7	≥ 41
8	≥ 45
9	≥ 49
10	≥ 53

Parts B and C: SAQs and VAQs: eight questions each marked out of 10

Score	Raw score	Number of questions passed
0	0	0
1	26	1
2	29	2
3	32	3
4	36	4
5	40	5
6	44	6
7	48	7
8	52	8
9	56	8
10	60	8

Both the raw score and the number of questions passed are required in order to obtain a particular grade.

2. Clinical component
Part A: Long case: one case marked out of 10

Part B: Short cases: four cases each marked out of 10

Score	Raw score (out of 40)
0	0
1	< 11
2	11–12
3	13–14
4	15–18
5	19–22
6	23–26
7	27–29
8	30–31
9	32–33
10	> 33

To pass overall, at least two of the four short cases must be passed.
If three cases are passed with a raw score of 15–18, a pass (five) is awarded.
If the raw score is 19 or more and only one section is passed, a score of four is awarded.

Part C: SCE: six stations each marked out of 10

Score	Raw score	Number of questions passed
0	0	0
1	21	1
2	23	1
3	25	2
4	27	3
5	30	4
6	33	5
7	36	5
8	39	6
9	42	6
10	45	6

Both the raw score and the number of questions passed are required in order to obtain a particular grade.

Source: www.acem.org.au.

Notification of results

Once you have completed the final clinical component, stay near the venue if you can, as the examiners meet shortly after candidates complete this component. Following this examiners' meeting, the list of successful candidates is prepared for posting outside the venue and on the College website, and individual envelopes are prepared containing

results. The envelopes are handed out at the designated time, usually approximately two hours after the clinical component has been completed. There is no distinction between the envelopes of 'successful' and 'unsuccessful' candidates: they all look identical, with only the candidate number on the outside. Those results not collected are mailed out to candidates.

The examination and the examiners' meeting are highly confidential. No one other than the Censor-in-Chief is permitted to discuss any information on any candidate or any other aspect of the examination outside of the examiners' meeting. Do not ask any examiner how you went. They are not permitted to discuss anything with you.

All candidates and their accompanying persons are then invited to drinks. Successful candidates are presented with a College pin and the winner of the Buchanan Prize is announced. The Buchanan Prize, named in honour of Peter Buchanan, one of the founding Fellows of the College, is awarded to the candidate with the highest score. Where two or more people have the same high score and other predetermined criteria are equal (including the number of sections passed and the number of examination attempts), the prize may be awarded to more than one person.

Who are the examiners?

> There are very few monsters who warrant the fear we have of them.
>
> *André Gide*

Examiners are clinicians who have successfully applied to become examiners. They are at least five years post-fellowship and have undergone an introductory process, including observing the primary and fellowship examinations. Examiners volunteer their time to assist in this important task.

Many examiners tend to be high achievers in other areas as well. You will most likely recognise authors of textbooks or other 'big names' in publishing, research or College activities. Do not be intimidated by this. Console yourself with the knowledge that not all examiners passed the fellowship examination on their first attempt! They are there because they want to assist you through the process. They really do want to see you pass — after all, it is far more satisfying from their perspective to be awarding pass marks. And remember, there is no requirement for anyone to fail: if everyone achieves the pass standard, then everyone passes.

Examiner pairs are usually selected from different regions. Each serves as a 'check' for the other to make sure that everything is done properly and that your comments and actions are accurately acknowledged. For the most part, one will lead a given section while the other scribes against predetermined criteria. Given the few examiners who are available at a sitting, it is not always possible to ensure that candidates are assessed by examiners who do not have conflict of interest issues with them. If one examiner is known to you, it is usually (but not always) the other who will lead that section.

Observers will also be present in some sections. They may be prospective examiners, site organisers, Directors of Emergency Medical Training (DEMTs) or other Fellows of the Australasian College for Emergency Medicine (FACEMs) who are *bulldogs*, gaining first-hand experience of the examination process. Non-FACEMs (e.g. advanced trainees) may be involved in the examination process, but they are not allowed to be present in the examination room.

You may occasionally find a scribing third examiner join the active pair. This is a 'peer support' examiner. Like the other observers, this person will not examine you and will not interact with you. Selected from the senior court of examiners, this person is

there to provide feedback to the examiners on *their* performance as a quality assurance measure. Even the examiners get examined!

Who prepares the exam questions?

> It is possible to store the mind with a million facts and still be entirely uneducated.
>
> *Alec Bourne*

All examination questions are prepared in advance. Designated subcommittees of the FEC prepare the MCQ, SAQ, VAQ and SCE scenarios. The examiners have no prior knowledge of the questions and do not have any say in which questions are assigned to them, so you will therefore be marked by 'peers', not experts in pre-assigned areas.

The SCEs are workshopped by the examiners at a pre-exam meeting the night before the clinical components commence. This is a finetuning exercise to determine the exact wording of questions, the timing of sections and the prompts that will be used when required and for the examiners to agree on the pass/fail criteria. SCEs are then 'tested' on other FACEMs at the meeting before being finalised.

The long and short cases are also unknown to the examiners prior to the event. They see them immediately prior to the examination, taking a history and examining patients *without* the clinical notes and within the time constraints imposed on the candidates. They agree on the presence or absence of clinical signs that *they* can find and determine which are crucial for candidates to be able to detect to achieve a pass. The notes are mostly used for the long case to provide investigation results for that individual.

The journey to the fellowship examination

> A journey of a thousand miles begins with a single step.
>
> *Confucius*

The best time to start preparing for the fellowship examination is as early as possible after you have completed the primary examination. Remember, you are preparing to become a competent emergency physician, not just preparing to pass another examination. Each component of the fellowship examination is an efficient way of demonstrating individual aspects of this. Even though you will be focused on 'book work' in the early stages, it is never too early to incorporate the principles of the written and clinical components as part of your everyday activity. This process is like making a deposit into a well-performing bank account, earning compound and better interest the closer you are to sitting the exam.

Obviously, the best way to become comfortable and familiar with doing things the 'examination' way is to do them routinely every day. During departmental teaching sessions, every question is a SCE, SAQ and/or VAQ opportunity. Develop a style for approaching these questions. Every case you see is at least a short case and potentially a long case. The short case examination technique is very time efficient. Develop a technique for each organ 'system' and use it on each and every patient you see. If the patient appears to have issues that would be well suited for a long case and is not acutely unwell, limit yourself to 35 minutes, spend five minutes collating your thoughts and then present the case to a colleague. If you have a sufficiently cooperative patient and 'study buddy' or colleague, ask your colleague to see the patient first, check the notes and then do it as a true 'mock' long case.

One of the most effective strategies for learning and consolidating your skills is to teach. Take the opportunity to present regularly in departmental education sessions. The person who gains the most from these sessions is the one standing in front of the group. You research the topic, organise your presentation and develop the skills of addressing questions. When junior staff seek out your advice, you are answering a SCE, SAQ or VAQ. Practise answering the actual question asked, not what you want the question to be! When you are asked to review a patient, you have an opportunity to demonstrate to junior staff how to do a short case examination and then present your findings. You can even extend the exercise and provide the answers to the questions an examiner would ask at the completion of the clinical examination.

Do not neglect the administrative aspects. Volunteer to help with departmental management, mentor junior staff, and offer to review guidelines, revise equipment lists and assist with dealing with some complaints. Depending on your department's structure, you may be able to join senior staff meetings and do some on-call shifts with consultant back-up. These experiences are invaluable in learning the components of being a competent FACEM that you do not get to see on the shop floor.

Read the curriculum and ensure that you gain some first-hand experience on every topic. Answering a question regarding something you have actually done is an order of magnitude easier and less stressful than trying to imagine how you would do it.

Core principles

Your goal is to become a competent emergency physician. To achieve this goal, you should constantly remind yourself of the following basic principles:

1. **The examination is like a day at work in a typical emergency department (ED), so you should be prepared for anything.** A typical ED has about a 25% paediatric load and sees all clinical conditions. If you are unfamiliar with children, pregnant women, the elderly, individuals with ophthalmology problems, trauma, mental health issues or any other aspect of emergency medicine practice, you need to address this. Visiting an antenatal clinic, working in a more 'mixed' department and visiting specialty outpatients are all potential opportunities for filling in any gaps. Such issues are best considered at the outset, when you are planning your training.
2. **Know what is *common* and what is *commonly deadly* if missed.** Not only is this obviously necessary for doing the job properly, but it is also a good indication of what questions are likely to be asked in the examination.
3. **Remember to treat the patient as a whole: consider the 3Cs.** Making the diagnosis (*condition*) is only part of treating a patient. If the initiating *cause* is left untreated, it will recur, despite treatment; and if an ensuing *complication* is not identified and managed, the patient will not recover. An easy way to remember these issues is to always consider the 3Cs: *condition* (diagnosis), *cause* and *complications*. This method, which we teach our trainees, has brought success to many FACEMs, including ourselves, and is discussed in more detail throughout the book. Although other methods exist, we have found this a useful tool over the years.
4. **When in doubt, ask what a 'real' FACEM would do.** To become a competent emergency physician, use one as a role model and guide. Ask yourself, 'If [insert name of your most respected FACEM] was in this situation, what would they do and how would they do it?' You get to see FACEMs in action all the time. Learn from them.

Preparing yourself

> Don't think you are; know you are!
>
> *Morpheus (The Matrix)*

The journey can be long and often lonely. The majority of trainees take approximately 12 months from the day of 'commitment' to prepare for the fellowship examination to the final examination. This is a significant period of time that requires much devotion to the task.

We typically advise our trainees that there are three basic components in their lives that they need to consider during the exam preparation phase:

- study
- work
- social life.

Regardless of intentions, most candidates (with the exception of a few extraordinary individuals) reflect that they can adequately manage only two of these important priorities. Recognising that study is mandatory and work is essential to maintain focus (and generally to meet ongoing financial requirements), there is an inevitable 'time out' from social activities.

A particularly insightful partner of an examination candidate described the process as 'like a pregnancy'. He had anticipated that his partner would change, and would be moody and less attentive as she coped with her exam preparation. All of this would be out of his control. In the end, however, all being well, there would be a *present* that was well worth the journey. The analogy is apt, and continues to the 'after' status. Once the examination is passed, you proceed to a more mature level of function within the medical system. You become one that others look to for guidance.

So you need to explain to your friends, family and loved ones as early as possible why your life may be put on hold. Apologise in advance for behaviour you will never remember. Explain the significance of the fellowship examination for your career and why it is different from all those exams that have come before it.

Juggling responsibilities is not easy for anyone, but the task will be even harder if you forget to look after yourself. Eating healthy foods, taking regular exercise, managing stress and sleeping well are important for all doctors working in Emergency Departments, but are even more essential during the run-up to the fellowship examination.

Where do you start?

The enormity of the task can appear overwhelming when it is viewed as a single entity. Break the task down in to *bite-sized chunks* and prepare a schedule to work your way through the curriculum. Having reached this stage of your medical career, you know what works best for you. Are you naturally a *night owl* or an *early morning rooster*? Develop a realistic schedule that is tailored to your biorhythms and work rosters and try to stick to it. Study complex topics (e.g. reading new chapters or journal articles) when you are at your most receptive and look at easier material (e.g. doing old MCQs) when you are tired. Your confidence will grow as you progress. Watching your 'to-do' list shrink as the 'done' section expands reinforces your ability to get there. If you are fortunate enough to be in a bigger centre with an established program, join in and keep up.

Which section should you prepare for first?

If you adopt the core principles outlined above, embedding them as part of your everyday practice, you will already be preparing for every section.

In your study program, try to ensure that you are not only progressing through the curriculum topics but also getting experience practising for each exam component. Regularly attempting previous questions or making up your own questions of different types and answering them at the start of a subsequent study session may achieve this. This also serves as revision. As you read new material, it is helpful to consider how the examiners could best examine that topic.

As the written component approaches, most people find they get maximum yield from focusing almost entirely on going over past questions and/or doing a lot of mock exams (obtain questions from mentors or fellow candidates or use your own). Practise writing briskly but legibly and setting out your responses in an organised and timely fashion. Use a stopwatch and get used to having hand cramps and fatigue *before* the big day.

Using a sporting analogy, it could be said that covering all the syllabus topics is like attaining a high level of *general fitness*, whereas practising individual sections of the exam is like preparing for individual competitive events. Despite acquiring a low resting heart rate and strong muscles, it is hard to win a long-distance marathon if you have only worked out in a gym and have never pounded the pavement!

Do not neglect the clinical component of the examination. Tackling this component will be substantially harder if you leave it until after you have done the written component. Leaving only 10–12 weeks is not enough time to prepare for the clinical component from a standing start. You see patients every day at work, so why not make your work as productive as can be? Consider every patient you see from this day forward as a short case, a long case or a missed opportunity.

Where can you find the best information?

The College website (**www.acem.org.au**) is a virtual goldmine of information, including the curriculum, examination reports, numerous guidelines, policies, position statements and other material covering every aspect of FACEM activity. The site also has the contact details for the College Secretariat, which will help you navigate the maze if you get lost. Spend a lot of time at this site.

In addition, the College has other avenues of immense value to you. Most importantly, read the College's *Training and Examination Handbook* in its entirety. Every site accredited for training has at least one DEMT who is familiar with training requirements and usually has a fellowship training schedule ready to go, even if no one else is sitting at that particular moment. Further up the 'ladder' are regional Censors and Deputy Censors who are always ready to help wherever they can.

There are a number of recommended texts: use those that work best for you. The reference list in Chapter 9 can give you a starting point, as it highlights what most FACEMs find of greatest value. In addition, the source journals listed in the chapter are those that are most read by FACEMs and so should guide you towards what will be foremost in the minds of your examiners, those who will be setting the questions and those who will be assisting you in your preparation.

Critique

Part of the pathway to success involves getting others to 'assess' your performance. Without constructive critique, you cannot correct deficiencies and improve. As you start presenting cases, practising written components and responding to probing questions, you will inevitably receive feedback that leaves you feeling deflated and despondent. There is no way to avoid this, so you need to develop a strategy to deal with it. Keep going — as you progress, this will happen less often. And remember, even your most admired FACEM occasionally gets things wrong and does not know all the answers. If they can handle it, so can you.

Study groups

> I am a brother to dragons and a companion to owls.
>
> *Job 30: 29*

A burden shared is a burden halved. Spending time with others going through the same experience is helpful, and groups of up to about six people can be especially so. You can keep each other on track, share fears and frustrations, test each other with MCQs, and take turns being examiner and candidate practising the written and clinical components. Taking turns being the 'examiner' is most fruitful. This gives you the opportunity to provide constructive critique instead of just receiving it all the time. Refining your own technique becomes an easier task after watching others make the same errors or watching something done well. A special benefit of practising in this manner is those magic moments when you get to laugh with each other when someone says or does something really, really silly!

Other specialists

Pairing up is also a good way to seek out useful clinics and consultant rooms in other specialties. Attending clinics or rooms gives you access to patients with good signs that you can present to a specialist in the field. If you examine these patients as short cases and then present them to the specialist concerned, the patients are usually impressed both by your proficiency (a slick examination always impresses) and by the knowledge that the specialist displays while interacting with you. It teaches you what is important for these patients, ensuring that you do indeed know when to refer and how best to investigate. Negotiating a regular presence for senior trainees will train a generation. Everyone wins from this process. Practise this introduction (or similar):

> Hi, we're preparing for our fellowship examination. We were wondering if we could join you in your clinic or rooms. Apart from seeing patients with good signs, we're especially interested in the details of management. This will allow us to ensure that all our referrals to you are appropriate and worked up properly.

Apart from tweaking the 'referral' buttons, the sentiment is genuine. Some of the fellowship examinations between specialties share common ground, and opportunities exist to occasionally join other trainees on their journey or share resources. For example, physician exam trainees always seem to know where patients with the best signs can be located. Intensive care fellowship candidates must undertake vivas that are not dissimilar to SCEs. Such interactions encourage a collegiate atmosphere to fellowship training within institutions and can reduce feelings of isolation.

Preparation courses/opportunities

> I have never met a man so ignorant that I couldn't learn something from him.
>
> *Galileo Galilei*

A number of formal and informal opportunities exist to participate in activities that will assist you in preparing for the fellowship examination. The ACEM Annual Scientific Meeting (late in the year) and Winter Symposium (mid-year) are excellent opportunities to meet other trainees and FACEMs from all regions. Oral and poster presentations can guide you on how to present and how questions can be addressed, and this can be enormously valuable when considering your own presentation/publication requirement.

Generally, each region has at least one local fellowship training program. Most make this accessible to others to join in, so even if you are not working at a site, you will usually be welcome if you provide a positive contribution.

Some regions have developed formal courses, including practice written examinations. Details are available on the College website.

In addition to courses specifically aimed at the fellowship examination, a number of other courses provide valuable learning experiences. The following list is not exhaustive, and you are strongly encouraged to talk to colleagues in emergency medicine and other specialties to determine what else is available.

ALS (advanced life support) course

A variety of course formats exist, with courses run regularly throughout Australasia. Courses approved by the Australian Resuscitation Council (ARC) can be accessed via its website (**www.resus.org.au**).

APLS (advanced paediatric life support) course

This three-day course addresses all aspects of paediatric emergency management. Even if you see children regularly, this course is valuable. If you can't get to the course, get a course manual.

See the course website for more information (**www.apls.org.au**).

EMST (early management of severe trauma) course

In Australasia, advanced trauma life support (ATLS) courses are designated EMST, which is an historical 'quirk'. Run by the Royal Australasian College of Surgeons (RACS), the same three-day course is run all over the world. 'Immersion' in trauma management is very effective. The surgical skills section provides an opportunity to perform procedures not normally accessible elsewhere (venous cut down, DPL, surgical airway). This section alone makes the course worthwhile. Unfortunately, waiting time for non-surgical trainees can be long.

More details are available under the Skills Training section of the RACS website (**www.racs.edu.au**).

ACME (advanced complex medical emergencies) course

Simulation training has matured significantly in recent years. A number of senior FACEMs have been involved in the creation and running of this high-intensity course, and more details can be obtained from the College website (**www.acem.org.au**).

CCrISP (care of the critically ill surgical patient) course

This course runs along a similar three-day format to the EMST course and is compulsory for surgical trainees. Based on MET-type principles of early recognition and management of medical complications, this course has broad application to surgical and medical conditions and has instructors from all the critical care specialties, as well as senior surgeons. A particularly valuable aspect of this course is its strong emphasis on communication skills. More details are available under the Skills Training section of the RACS website (**www.racs.edu.au**).

EMSB (emergency management of severe burns) course

If trauma appeals to you and/or management of burns is something you need to be more familiar with, this course has it all. The course is run by the Australia and New Zealand Burn Association (ANZBA), and course dates and information can be obtained from the Health Care Professionals section of the ANZBA website (**www.anzba.org.au**).

Keeping it all together

Preparing for the fellowship examination is a stressful undertaking. As the first exam date draws closer, your stress levels will rise, and you *must* have a strategy to deal with this. Keeping to your schedule is vital, as is looking after yourself. Many students plan some block time off to study prior to the written component. Remember, however, the significant others in your life and quarantine some time away from work and study to spend with them. Make a plan for regular 'dates' with your partner, family and/or friends: go for walks together, have a meal together with no books in sight or whatever else you agree upfront. One hour a week can make all the difference to your relationships and friendships. Never break these dates! Talk about your frustrations together and plan for your life after the exam: make a list of the things you would like to do and the people and places you would like to visit.

Some of our trainees have found enormous benefit from engaging the services of a professional such as a sports psychologist to assist in their preparation for the exam. Candidates whose performance is impaired by significant anxiety and/or those who have experienced an episode of failure may particularly benefit from the practical strategies that such professionals can impart.

Creating the right impression

> You never get a second chance to make a first impression.
>
> *Unknown*

What you wear for the examination can help create the right impression. Remember, revealing outfits usually have a negative impact. Examiners and the majority of candidates wear suits for the clinical components of the exam. Although such dress is not mandatory, ask yourself whether you really want to stand out from the crowd in this respect. This does create a somewhat artificial situation, as this is not what clinicians typically wear at work, but it is a form of examination 'tradition' — better to embrace it than resist it.

Examination attire is not well suited to carrying the tools of the trade. You will be expected to provide your own stethoscope, tendon hammer, cotton wool, sharp pins, torch, tongue depressors, ruler or tape measure, visual acuity chart and red hatpin for testing visual fields. Most candidates prefer to use their own ophthalmoscope and auroscope for familiarity, although this is not essential. Decide early on whether you want to carry them all in your pockets or a bag/briefcase.

A number of candidates carry small toys to placate/distract children. If you decide to do so, choose carefully. Ensure that they are child-safe and avoid ones that make any noise that will make your examination more difficult. If your ploy works, it may be hard to retrieve the items in the time constraints available. Be prepared to gift them.

Whatever choices you make regarding your attire, diagnostic tools and paediatric distracters, decide ahead of the event and practise, practise, practise examining patients in this manner so that you are comfortable and don't fumble around trying to find things. At least a couple of practice sessions are essential. Use a tiepin/hair tie to ensure your tie/hair doesn't drape on the patient.

However, the most important component of the impression you create is your attitude. Recall your intention to be a competent emergency medicine specialist and be one. Take each question you are asked as a lead to a discussion with a colleague. There will be no traps or hidden agendas. The examiners genuinely want to hear what you know. Conversely, they don't want to be argued with. Your responses should be considered, to the point and not waffly. Speak audibly at a pace you are comfortable with. If you are not sure what a question means, politely say so and it will be rephrased. Do not be concerned

when the topic changes. Each new question is an opportunity for you to demonstrate your competence in another area and the examiners may be deliberately trying to lead you in order to maximise your overall score on their marking template.

Do not be concerned if the questions become more and more detailed. The examiners may be giving you an opportunity to show just how much you know (to get a higher score). If you get to the point of saying 'I'm sorry, I don't know', they have achieved this. Be comfortable saying this and take extreme care in guessing answers. Wildly inappropriate answers may significantly detract from your performance, particularly if what you have conjured shows poor judgement.

Travel considerations

> No one realizes how beautiful it is to travel until he comes home and rests his head on his old, familiar pillow.
>
> *Lin Yutang*

Depending on the location of the examination, a long trip and change of time zone may be involved. Plan to arrive in sufficient time to find your way around in daylight (including the route to the venues) and adjust to time zones if necessary. On the day, plan to arrive well in advance of the examination start time. Being held up in traffic watching the clock tick is not a good way to spend the moments immediately before the exam.

Make yourself comfortable in good accommodation away from noise. If you choose to travel with your support person(s), this is especially important. Plan how you will interact with them over the days of the clinical components and ensure this is optimal for your performance. Others with you are welcome to join you at the post-examination drinks.

If you are to be quarantined, make sure you are prepared for this eventuality. We would caution against having detailed discussions about the exam, because talking with other candidates can inadvertently detract from your confidence. Polite social conversation is acceptable and can help pass an anxious waiting period, but some candidates may prefer to wait quietly alone and this should be respected.

Coping with failure

> Our greatest glory is not in never falling, but in rising every time we fall.
>
> *Confucius*

Excellent preparation is the best way to avoid failing. Spend quality time with your DEMT(s) and heed their perception regarding your readiness for the exam. If they think you need more time to prepare, then maybe you do. Look out for well-meaning individuals who tell you that it can be useful to have a go 'for experience' or 'just in case you get lucky': this is questionable advice.

Remember, no matter how much time and effort you have invested in the study process, no one is immune from the possibility of failing. Accordingly, our advice is to have a strategy in place for dealing with this contingency. When the envelopes are handed out after the examiners' meeting, most unsuccessful candidates tend to slip away quietly, but all are welcome to the drinks session. Different candidates deal with the situation in different ways.

If you are unsuccessful, you will be notified by mail of your marks in each section of the examination. You may also request further feedback from the Censor-in-Chief,

who can discuss your performance with you via telephone in the weeks after the exam. Your DEMT(s) should also be able to debrief you and offer confidential counselling and support, as well as help you plan for the future.

Key points

- Ensure that you are familiar with the most recent ACEM documents pertaining to the exam, which can be found on the College website (**www.acem.org.au**).
- Develop a strategy for exam preparation that maximises your personal effectiveness and manages stress, as well as addressing how you and those around you will cope best with the journey to fellowship.

Chapter 2

Multiple-choice questions

> Every problem has a gift for you in its hands.
> *Richard Bach*

The multiple-choice question (MCQ) section of the written component causes a great deal of anxiety for many candidates. As with most MCQ examinations, it is possible to leave the exam room feeling that you know nothing but actually still have passed.

The MCQ section is therefore very difficult to study for, other than reading the recommended fellowship textbooks and high-impact journals closely, since all possible answers in an MCQ 'should be referenced to at least one (and ideally multiple) texts from the College's recommended text list' (ACEM, *Training and Examination Handbook*, 2008). After you have consolidated your knowledge base, practising critical time management and MCQ technique on a lot of sample questions is the key to improving your performance in the actual exam.

Candidates are often told that some MCQs are re-used to assess inter-examination correlation and to enable differentiation between candidates performing at various levels. We caution against overreliance on previous questions, because banking on pattern recognition is supremely unreliable.

Although this section of the exam correlates well with overall performance, most people, with the exception of the outstanding candidates, leave the MCQ session feeling dispirited, unsure whether they have correctly answered enough questions to pass. Many will not have encountered any questions similar to or even vaguely resembling those used in their practice sessions. Although you may feel discouraged, it is crucial that this does not impair your performance in the other sections of the written component. As for all components of the exam, we recommend that you do not discuss your answers with other candidates during any rest periods, as this can lead to a false sense of reassurance or, worse, a conviction that you have performed badly when you have not.

Purpose

The MCQ section aims to test a *broad* range of factual knowledge in the fellowship curriculum. Paradoxically, each question generally targets a *narrow* area of the syllabus (see Table 2.1). Topics that are difficult to cover in other sections of the exam are often included here.

TABLE 2.1 Typical mix of MCQs

Topic	Number of questions	Topic	Number of questions
Medicine			
Cardiovascular	4–6	Rheumatology	0–1
Respiratory	4–6	Dermatology	0–1
Gastrointestinal	1–3	Infectious diseases	1–3
Neurology	2–4	Immunology	0–1
Endocrine	1–2	Metabolic	0–2
Haematology	0–1	Acid base	0–2
Oncology	0–1	Neonates and infants	0–2
Renal	0–2		
Surgery, and obstetrics and gynaecology			
Trauma	2–4	Neurosurgical	0–2
Burns	0–2	Urology	0–2
Dental	0–1	ENT	1–2
Thoracic	0–1	Eye	1–2
Abdominal	1–3	Wounds	0–1
Anorectal	0–1	Plastic	0–1
Vascular	0–2	Breast	0–1
Orthopaedic	3–5	Obstetrics and gynaecology	1–2
Other specialties			
Principles of emergency medicine	0–2	Clinical risk management	0–1
Resuscitation	1–3	Pre-hospital and retrieval	0–1
Anaesthetics	1–3	Disaster	0–1
Psychiatry	1–3	Medical education	0–1
Toxicology	3–5	Administration and management	0–2
Environmental	1–3	Research and literature appraisal	0–1
Radiology	1–2	Procedures and skills	0–2
Legal	0–1		

Source: www.acem.org.au.

Format

This section comprises 60 questions to be answered over a period of 90 minutes, giving you approximately one and a half minutes per question. In addition, you have 10 minutes of reading time prior to commencement. The questions are all type 'A' MCQs. This type of question contains a 'stem' — an introductory statement or paragraph — followed by a choice of five possible responses labelled (a) to (e).

- Approximately 80% of questions seek a *single correct response* from five possible responses, with 'TRUE' being clearly displayed in the stem. For these questions, there is only one correct 'best' answer, although frequently two or more responses may potentially be correct at face value. One of the hardest aspects of the MCQ exam is deciding which single response is more correct than the others, when none of the possibilities are clearly wrong.
- The remaining questions seek the *only incorrect answer* from five possible responses, with the word 'FALSE' being clearly displayed in the stem.

There is no negative marking in the MCQ section, so ensure that you answer every question. The pass mark is 55% (or 33 correct answers out of 60). This allows for the possibility that candidates may simply guess a percentage of answers correctly.

According to the ACEM *Training and Examination Handbook* (2008), one-third of the section will cover medicine, one-third will cover surgery/obstetrics and gynaecology, and the final third will cover the remainder of the curriculum, as outlined in Table 2.1 (this matrix is in the latest edition of the ACEM *Training and Examination Handbook*).

Preparation

Since the MCQ section tests candidates' theoretical knowledge, general preparation in the form of specific learning based on the fellowship curriculum is essential. The breadth and depth of emergency medicine theory and practice covered in this component can be extremely daunting. If you are time pressured, you could focus in greater depth on the first two curriculum areas covered by the MCQs (medicine, and surgery/obstetrics and gynaecology).

An equally important aspect of preparation for this section is practice. The more sample MCQs you answer, the more likely your chances of success. Practise using type 'A' questions, as this will prepare you for the format used in the exam.

You can find practice MCQs in a number of places, including the College website and a number of other websites (see Table 2.2). Alternatively, you can purchase MCQ books that cover specific areas of the curriculum (see Table 2.2), or your DEMT and colleagues should have some 'old' questions (either ones that have been written by previous candidates or ones that have been 'passed down'). However, don't rely on the exact wording of what people have recalled from past examinations. Very few candidates score 100% and memory is notoriously unreliable for the sort of detail that makes the difference between a correct answer and an incorrect answer. Use these questions simply as guides to topics.

Finally, writing your own MCQs to quiz your colleagues and having them do the same for you is one of the best ways of preparing yourself for this type of question. The FACEMs setting the exam do this. If you do it as well, you are likely to come up with similar questions, but they have to be based on the best or latest evidence from the College's recommended text or high-impact journals list.

TABLE 2.2 Useful sources of MCQs

Websites	Books
• Emergency Medicine Multiple Choice Questions (EM.MCQ) at **www.applecoresoftware.com** • Surgical Tutor MCQ at **www.surgical-tutor.org.uk**	• Herlihy A. Get Through Accident and Emergency Medicine: MCQs. Royal Society of Medicine Press Ltd, London, 2006. • Galvani DW et al. MCQs for the MRCP Part 1: Infectious Disease, Haematology and Chemical Pathology. Baillière Tindall, 1999. • Johnston DI and Hull D. Essential Paediatric MCQs. Churchill Livingstone, 1995. • Parks RW and Diamond T. Surgery MCQs and EMQs. Greenwich Medical Media, London, 2005.

MCQ creation process

The MCQ Exam Committee creates questions utilising and referencing existing and evolving information. The committee then workshops these questions and reviews them following each exam. Some examples of questions developed utilising this process are shown below.

Sample MCQs

MCQ 1

In the management of croup in children, which one of the following is TRUE?

a Use of single-dose oral dexamethasone is effective in mild croup.
b Recommending use of steamed warm air generated in an enclosed bathroom at home has been shown to be effective in alleviating croup symptoms.
c Recommended corticosteroid in the treatment of croup is either single-dose oral dexamethasone 1 mg/kg or oral prednisolone 0.1 mg/kg.
d Helium–oxygen mixtures have been shown to be of unequivocal benefit in infants with severe croup.
e Oral prednisolone has been the most frequently studied corticosteroid in croup.

Correct answer: **a**.

Source material

- Bjornson CL, Klassen TP, Williamson J et al. A randomized trial of a single dose of oral dexamethasone for mild croup. NEJM 2004; 351:1306–1313. 'Conclusions: For children with mild croup, dexamethasone is an effective treatment that results in consistent and small but important clinical and economic benefits. Although the long-term effects of this treatment are not known, our data support the use of dexamethasone in most, if not all, children with croup.'
- Moore M, Little P. Humidified air inhalation for treating croup. Cochrane Database of Systematic Reviews 2006, Issue 3. Art. No.: CD002870. DOI: 10.1002/14651858.CD002870.pub2. 'The croup score of children managed in an emergency setting with mild to moderate croup probably does not improve greatly with inhalation of humidified air. Further research is needed in primary care settings, using a wider range of more sensitive outcome measures.'
- Geelhoed G. Chapter 6.7 Croup. In Cameron P, Jelinek G, Everitt I, Browne G, Raftos J. Textbook of Paediatric Emergency Medicine. 1st edn. Elsevier, Sydney, 2006. 'The recommended dose of corticosteroids for croup in Australasia is either single dose oral dexamethasone 0.15 mg/kg or oral prednisolone 0.75 mg/kg.'
- Vorwerk C, Coats T. Heliox for croup in children (protocol). Cochrane Database of Systematic Reviews 2007, Issue 4. Art. No.: CD006822. DOI: 10.1002/14651858.CD006822. 'It remains unclear whether there is any evidence to support the implementation of heliox for croup in clinical practice.'
- Russell K, Wiebe N, Saenz A, Ausejo Segura M, Johnson D, Hartling L, Klassen TP. Glucocorticoids for croup. Cochrane Database of Systematic Reviews 2004, Issue 1. Art. No.: CD001955. DOI: 10.1002/14651858.CD001955.pub2. 'Dexamethasone and budesonide are effective in relieving the symptoms of croup as early as six hours after treatment. Fewer return visits and/or (re)admissions are required and the length of time spent in hospital is decreased in inpatients. Dexamethasone is also effective in mild croup populations.' (There are few studies using prednisolone.)

MCQ 2

With regard to thrombolysis or aspirin in acute ischaemic stroke, which one of the following is FALSE?

a ECASS III suggests lytic therapy is still able to achieve a better neurological outcome when administered six hours after the onset of stroke symptoms.
b One hundred and eighty minutes after stroke symptom onset remains widely advocated as the therapeutic time window in which a benefit may still be derived with lytic therapy.
c Oral aspirin confers a benefit if used within 48 hours of the onset of ischaemic stroke.
d Unfractionated heparin may be beneficial in acute ischaemic stroke due to a cardioembolic source.
e In ECASS III, treatment benefit from lytic therapy outweighed the risk of symptomatic intracranial haemorrhage attributable to lytic therapy.

Correct answer: **a**.

Source material

- Hacke W, Kaste M, Bluhmki E et al. Thrombolysis with alteplase 3 to 4.5 hours after acute ischemic stroke. NEJM 2008; 359:1317–1329. 'Conclusions: As compared with placebo, intravenous alteplase administered between three and four and a half hours after the onset of symptoms significantly improved clinical outcomes in patients with acute ischemic stroke.' Risk difference of favourable outcome with alteplase = 7.2%. Risk difference of symptomatic intracranial haemorrhage with alteplase = 2.2%.
- Wardlaw JM, del Zoppo GJ, Yamaguchi T, Berge E. Thrombolysis for acute ischaemic stroke. Cochrane Database of Systematic Reviews 2003, Issue 3. Art. No.: CD000213. DOI: 10.1002/14651858.CD000213.
- Aplin P. Chapter 7.2 Stroke & TIA. In Textbook of Adult Emergency Medicine. 2nd edn. Elsevier, Sydney, 2004.

On the day

Reading time

You have 10 minutes of reading time before commencing the exam during which no writing is allowed. You can maximise your use of this time in a number of different ways. One approach is to use this time as part of the exam time. Start answering the questions in the usual time frame, but since you cannot write anything, you need to remember the answers until you can. Another approach is to spend the time scanning as many of the questions as possible in order to start thinking about the content.

Answering the questions

Remember these important points:

- You have plenty of time to answer all the questions, so there is no need to race through the exam. If you take the time to calmly consider each question, you are less likely to make silly errors.
- Ensure that you answer the question that is asked. If the *most correct answer* is required, the word 'TRUE' will be displayed prominently in the stem. Conversely, if the *most incorrect answer* is being sought, the word 'FALSE' will be displayed prominently in the stem.

This section is marked by a computer and candidates input their answers onto a paper answer sheet. For the computer to be able to mark accurately, for each question only one answer circle can contain a mark. For this reason, the answer sheet needs to be filled in using 'lead' pencil. Note the instructions on completely filling the circles. Do not use ticks, crosses or other marks. If you make a mistake, ensure that you completely erase any extra marks. Sample answer sheets can be found on the College website (**www.acem.org.au**).

There are two approaches to completing the answer sheet:

- You can enter the answer as you read each question, the advantages being that you are less likely to enter answers in the incorrect spot and it can save a small amount of time.
- You can write your answers to all the questions on the question sheet first, then transcribe them to the answer sheet, the advantage being that you can check all your answers prior to entering them on the answer sheet. However, the disadvantages to this method are that, unless you are careful, it is possible to run out of time before you complete the answer sheet, and if you accidentally miss transcribing an answer, you can put all your answers on the wrong line. To avoid this, keep a constant check that question and answer numbers match.

Whichever approach you take, it is worthwhile putting your answers on the question sheet, as this can assist with your later checking.

If your answer sheet is damaged or you consider that it will not be able to be interpreted by the computer, you can ask for a replacement — in which case, it is very useful to have written your answers on the question sheet!

Your confidence and therefore thought processes may be improved by answering those questions that you are sure of first and going back to the more difficult questions on your second and subsequent run through the paper. Improve your chances of answering correctly by excluding any obviously incorrect answers first. Finally, be cautious in changing answers once you have committed to a response, as it is commonly believed that initial judgements are more likely to be correct — your practice questions should help determine whether this is true for you.

Key points

- Write your own MCQs and share them with your study group.
- Decide on your MCQ answering strategy ahead of time, practise it and stick to it in the exam.
- Aim to answer *all* questions, since there is no negative marking.
- Remember the correct answer is the *most correct* answer. Be aware that other options may be correct, but not as emphatically!
- Maintain your focus and positive attitude during the exam. It may seem an impossible task, but your accumulated knowledge will shine through.

Chapter 3

Short-answer questions

> Learning is finding out what you already know.
> *Richard Bach*

The short-answer question (SAQ) section is regarded as one of the more challenging components of the exam. While it examines general knowledge of emergency medicine topics and scenarios, the format in which it is presented tests candidates' ability to link multiple concepts as well as provide detailed knowledge for individual areas. Since it is difficult to judge the balance between the breadth and depth of information required to score good marks, the SAQ section can be quite draining. Well-structured answers showing a logical, systematic approach will be more successful than simply writing to exhaustion in an overelaborate manner.

Purpose

The aim of this section is to test both theoretical and practical knowledge covering a broad range of topics related to the practice of emergency medicine.

Format

There are eight questions to be answered over a period of two hours, giving approximately 15 minutes to answer each question. In addition, 10 minutes of reading time is allocated at the beginning of the exam during which no writing is permitted. It is normal at the end of the SAQs not to be able to control your cramped writing arm!

Six questions cover the 'core' topics: administration, medicine, trauma, paediatrics, resuscitation/anaesthetics and surgery. Others may be sourced from the following topics: emergency medical systems/public health, ENT/eyes, environmental, obstetrics/gynaecology, psychiatry, toxicology and minor trauma (including orthopaedics). As with all sections of the exam, individual questions may cover more than one topic.

Questions can be posed in a number of different ways. The majority will involve a clinical scenario: remember that every word in the scenario has been specifically chosen for a reason and is important in answering the question. The remainder of questions ask you to write about a certain subject or how you would approach a particular situation.

Questions may comprise up to three parts, and each part will be given a specified percentage value of the total mark for that question. You need to reflect this percentage breakdown in your answer.

The College has produced a glossary of terms used in the fellowship exam, which is available for use in the exam room (see the glossary at the back of this book). Utilise this list when answering the questions: answering about *treatment* when *investigations* have been requested will *not* score marks.

Preparation

Questions can be taken from almost anywhere in the curriculum. Thus, general preparation in learning the curriculum goes without saying. In addition, most of the questions will address issues that present in your day-to-day practice. Working in an ED setting will greatly enhance your ability to answer these questions.

Although the range of topics that may be covered is almost endless, there are a number of recurring themes, many of which overlap. Practice questions can be sourced from your DEMT and other consultants, or you and your colleagues can write them for each other. Table 3.1 outlines the major topics that should be practised or at least considered. There is a significant overlap with lists of likely VAQ and SCE topics. This reflects the fact that certain core topics are consistently tested in one format or another during the examination process.

As with much of your exam preparation, practice in answering SAQs is vital. Every time you answer an SAQ, complete it in the required time frame (15 minutes) and ask someone (preferably a FACEM) to mark it. Over time, you can progress to 'half' (four-question) and full-practice exams. Do them under exam conditions where possible, including a proportional amount of reading time.

During your preparation, it can be useful to develop some standard templates for answering certain types of question. Tables, flow charts and diagrams are acceptable as part or all of an answer and are particularly relevant for certain types of question. Table 3.2 provides some examples of answer templates for certain types of questions. The table is arranged as per the College's glossary of terms for the fellowship examination. Some of these templates will be relevant for answering other question types, such as VAQs and SCEs, in a more structured manner.

The answer book for the SAQs is similar to that used for the primary examination. A sample is available on the College website (www.acem.org.au). Practise writing your answers in these answer books and using the templates given in Table 3.2. It is worth trying to write your answers on every second line, since this not only facilitates legibility but also gives you space to insert new material should you recall more information later.

We recommend writing a *brief* outline or 'plan' at the start of each answer. It is helpful if you can consider what this will be during the reading time. A good outline provides a structured, logical, sequential response and helps trigger recall of relevant material. If you run out of time to provide a full answer and provide only an annotated plan, at least the examiner will see your intentions and may reward you with marks you would not otherwise have obtained. Avoid writing excessively long plans, as this detracts from their purpose.

The aim of the SAQ is to impart as much knowledge as possible in a brief, logically structured and concise format. Point-form answers using standard abbreviations are preferred. 'Essay-style' answers can be a less efficient method of communicating information and are discouraged.

Using a template immediately gives your answers subheadings. This makes it easier for the examiners to read and mark your work, particularly if you lay out the sections in a controlled, legible fashion. A well-structured introduction and a concluding statement can link together the material for maximal impact.

For 'treatment' and 'management' questions in particular, it is often useful to consider the 3Cs (condition, cause and complications) and not just the condition when formulating answers. Try to tailor the template to the question by providing examples of the key relevant history, and what you would be looking for or expecting to find on examination or from specific investigations. A few examples for each subpoint are expected (e.g. in suspected renal colic, ward test urine for haematuria to support diagnosis and examine abdomen to exclude AAA if elderly).

TABLE 3.1 Potential SAQ topics

Subject	Topics	Subject	Topics
Administration	Management guidelines ED flow Access block/ ambulance bypass/ ramping Complaint/incident management Benchmarking Rostering Workforce planning Duty of care Handover Consent Confidentiality issues Domestic violence Elder abuse Alleged assault Colleague misdemeanour/poor performance Interdepartmental conflict Bullying Media interactions VIPs	**Paediatrics**	Febrile child Sepsis in infants < 3 months Respiratory distress Abdominal pain (including intussusception and pyloric stenosis) Non-accidental injury Investigation of jaundice Neonatal emergencies Investigation of UTI Approach to undifferentiated abdominal pain Foreign bodies — nose/ ear/ingested/inhaled Nappy rash
Medicine	Chest pain Ischaemic heart disease Dysrhythmias Respiratory failure Pneumonia Severe asthma Hepatitis Strokes, including lysis Myopathies, including acute respiratory failure Acute confusional state Pyrexia of unknown origin Severe sepsis Neutropaenic sepsis Diabetic emergencies Thyroid emergencies Addisonian crisis Electrolyte disturbances Anaphylaxis Mono-/polyarthritis End-of-life care issues Investigation of renal failure	**Emergency medical systems/ public health**	Trauma networks Retrieval coordination Disaster management Multi-casualty arrival to ED Pandemic planning Notifiable diseases — contact tracing/staff and patient exposure Occupational risk exposures (e.g. meningococcal sepsis, needle-stick injury) Paediatric immunisation

(Continues)

TABLE 3.1 Potential SAQ topics (Continued)

Subject	Topics	Subject	Topics
Trauma	Investigation modalities Approach to specific trauma issues (e.g. pre-hospital care, damage control surgery) Burns management Difficult airways Crush syndrome Compartment syndrome Difficult vascular access Multi-casualty events	**Surgery**	Acute abdomen Abdominal pain in the elderly Bowel obstruction Pancreatitis Urological emergencies GI haemorrhage Vascular emergencies — ischaemic limb/AAA/ thoracic aneurysm
Psychiatry	The acutely disturbed patient Suicide risk assessment Restraint Sedation	**Toxicology/ toxinology**	Intentional overdose — mixed or single agent Unintentional overdose or drug interactions Snake/spider envenomation
Resuscitation/ anaesthetics	High acuity patient scenarios Intubation/extubation Procedural sedation Regional anaesthesia Drainage methods for pneumothorax Early goal-directed therapy	**ENT**	Foreign bodies in children Epistaxis Post-tonsillectomy haemorrhage Airway obstruction Neck infections
Ophthalmology	Foreign bodies/ penetrating injuries Red eye Acute loss of vision Glaucoma — narrow/ open angle	**Environmental**	Hypo/hyperthermia Toxicology
Obstetrics/ gynaecology	Early pregnancy bleeding Late pregnancy complications, especially secondary PPH, pre-eclampsia/ eclampsia HELLP syndrome Trauma and pregnancy Emergency childbirth Amniotic fluid embolism Peri-mortem caesarean section Sexually transmitted infections (e.g. pelvic inflammatory disease)	**Localised minor trauma (including orthopaedics)**	Simple and complex lacerations Specialised areas — lips, face, eyelids, ears Peripheral injuries — complex nail injury, compound digital fracture Tooth fracture/dislocations Major joint fracture/ dislocations Eye injury

TABLE 3.2 Sample SAQ answer templates

Question type	Possible templates
Assessment	**History** *Stable patient:* presenting complaints and details, past history (medical, surgical, obstetric, birth and development, psychiatric), social history, allergies, medications (prescribed, over the counter, alternative therapies), immunisations, systems enquiry including focus on conditions to consider/exclude. *Emergent setting:* AMPLE history (allergies, medications, past history, last oral intake, events). **Examination** *Stable patient:* general appearance, vital signs, each organ system (cardiovascular, respiratory, hepatic, gastrointestinal, renal, neurological (central and peripheral), musculoskeletal, haematological, endocrine, dermatological). *Emergent setting:* primary survey (ABCDE), then focused secondary survey (head-to-toe examination). Full examination if/when able. **Investigations** *Bedside:* e.g. dipstick urine, BSL, ECG, blood gas, focused ultrasound. *Laboratory:* haematology, biochemistry, microbiology, other. *Radiology:* plain imaging, ultrasound, CT, MRI, angiography. Investigations can be listed either in the order above if the differential diagnosis is broad or as specific investigations to confirm/exclude individual diagnosis where the list is smaller (e.g. in stroke, CT scan of brain to exclude haemorrhage, followed by chest X-ray to exclude aspiration and then U&E for biochemical derangements associated with dehydration if unable to drink).
Discuss	**Tables** are often useful (e.g. simple grid with **pros and cons** *or* **advantages and disadvantages** for each alternative under discussion). Specifically consider **controversies/unanswered questions** — quote key papers if possible.
Disposition	**In-patient:** ED observation ward, hospital ward, HDU, ICU, inter-hospital transfer. **Outpatient:** home, GP referral, specialist referral, community or at-home assessment and interventions.
Interpret	Provide the **most likely diagnosis** then a **differential diagnosis**. For differential diagnosis templates, see 'list' section below.
Investigations	See 'assessment' section above.
List	Use a logical, relevant order. If referring to a **differential diagnosis**, the most important or most likely diagnosis should be presented first and given maximal emphasis. Some subjects may have pre-prepared lists. In the absence of an existing list, construct one by considering a generic list of **possible causes**. For example: **Pathophysiological classification** 1. **Congenital** or **acquired**. 2. For **acquired**, use a mnemonic such as VINTMEDATI: **V**ascular **I**nflammatory/infectious (bacterial/viral/fungal/protozoal/other) **N**eoplastic (benign/malignant — primary/secondary) **T**raumatic (including non-accidental, especially paediatric and elderly)

(Continues)

TABLE 3.2 Sample SAQ answer templates (Continued)

Question type	Possible templates
List (continued)	**M**etabolic **E**ndocrine/environmental **D**egenerative **A**utoimmune/allergic **T**oxic **I**diopathic (always leave to last) including drug-related. **Other classifications** • **Organic versus psychiatric** (e.g. causes of abnormal behaviour). • **Pragmatic classification** — most common, most potentially lethal, most forgotten causes (e.g. causes of chest pain). • **Anatomic classifications** (e.g. causes of desaturation in a ventilated patient — consider possibilities from the gas source to the circuit and tube to the patient's airway, lungs and chest wall; jaundice — obstructive versus non-obstructive; bowel obstruction — small versus large bowel; luminal, intraluminal or extraluminal pathologic lesions; renal failure — pre-renal, renal and post-renal causes). • **Infective versus non-infective** causes (e.g. causes of lymphadenopathy); infective causes can be bacterial (Gram +ve, –ve, anaerobes, mycobacteria, atypicals), viral, protozoal, fungal. • **Malignant versus non-malignant** causes (e.g. causes of coin lesions on a chest X-ray).
Management	The College definition is *specific treatment*, *supportive care* and *disposition*. Investigation, however, may be an essential part of patient management (e.g. in febrile or trauma patients), but if the diagnosis is already clear, investigation would not attract marks in a management question. For an emergent setting one approach is to simultaneously: • **resuscitate** — identify and treat immediate threats to life (ABCDE/ATLS approach) • **investigate** — determine a probable diagnosis and differential diagnosis through assessment (see 'assessment' section above) • **definitively treat** — divide into **supportive** versus **specific treatment** (medical/surgical/other interventions) • **plan disposition** — appropriately for condition and response to treatment
Outline	This is similar to 'describe' (which is self-explanatory) but can be structured for specific conditions, procedures and practice guidelines. If referring to a **specific condition**, divide into: • background — provide a brief overview; set the context • pathophysiology • size of problem — incidence/prevalence (common/rare), morbidity/mortality, risk factors/causes, medicolegal relevance • presenting features — history, examination, investigation findings • differential diagnosis (see 'list' section above) • treatment — supportive versus specific (usually medical/surgical/other interventions) • prevention • outcomes and follow-up. If referring to a **procedure** or practice guideline: • background (as above) • indications • contraindications • precautions • preparation (staff, equipment, setting, patient e.g. fasting) • process of procedure in detail

TABLE 3.2 Sample SAQ answer templates (Continued)

Question type	Possible templates
Outline (continued)	• possible complications (and treatment) • recovery • discharge criteria (or disposition if not discharged) • discharge instructions • follow-up • notes/variations for subgroups e.g. paediatrics • references/evidence base.
Protocol	Protocols are useful to ensure consistency of practice against agreed best practice. General headings to consider: • rationale (for needing a protocol) • background knowledge (the evidence base for the protocol, including performance and predictive characteristics of the protocol) • target (which patients and what criteria to identify/exclude them) • recommendations (a flow chart 'algorithm' can be helpful) • special considerations (e.g. costs, special equipment/training) • governance issues (process and time line for audit, responsible staff signing off on the protocol, date of introduction and review) • notes/variations for subgroups e.g. paediatrics • references/evidence base • authorising person/body and date • review date and history.
Treatment	See 'management' section above.
Other	For **administration** questions consider all **stakeholders** that may be relevant to a complex issue: patients, relatives/carers, nursing staff, medical staff (junior and senior), ED, GPs and other specialists, allied health workers, pre-hospital care workers, hospital administrators, health department, medical board, training authorities (e.g. ACEM), medical defence organisations, media/general public, the law/police When discussing **transport options** consider road, fixed wing, rotary. When discussing **analgesia options** consider routes of administration (oral, intravenous, subcutaneous, intramuscular, inhalational, nasal, sublingual, rectal), classes of agents to be used and other therapeutic options. When discussing **anaesthetic techniques** consider general anaesthesia and blocks (local infiltration, peripheral nerve blocks, regional blocks). Any answer about **paediatrics** must have considered consent issues, immunisation status, development, non-accidental injury, communication with child or family.

On the day

Use your 10 minutes of reading time wisely. Read through the whole paper and decide which questions you are more likely to be able to answer well. Use this time to plan the format in which you will answer the questions and the order in which you will tackle them. Some people prefer to answer the questions in order, whereas others prefer to start with the question(s) they feel more confident with. The latter option has the advantage of your writing being at its best when you have the most information to impart.

Maintain your focus on what each question is asking using the definitions supplied by the College. Do not transcribe the question onto the answer booklet before answering it as this wastes valuable time and is not necessary.

Be aware that by the end of the two hours, you will be both physically and mentally fatigued and can easily lose track of time. Have a reliable method of timekeeping and

keep to your self-allocated time frame for each question. It may be worthwhile writing down the number of minutes you have to spend on the sections within each question (or the start/finish times) proportionate to the percentage value designated.

Ensure you answer *all* questions. The marking system rewards consistency above high scores on individual questions. Failing to provide an answer to a question will substantially reduce your overall mark. If you have time remaining at the end of the exam, you can go back and 'fill in the gaps' for those questions where you have additional relevant information.

Worked sample SAQs

The following worked examples show the types of questions that may be encountered in the exam.

SAQ 1: resuscitation/toxicology

A 20-year-old male presents to ED one hour after being bitten by a snake. He collapsed 20 minutes after being bitten and since then has been vomiting blood-stained fluid.

(a) Outline your initial assessment of this patient. (50%)
(b) Outline your immediate treatment. (50%)

Sample answer

Plan

- Overview
- Initial assessment — history, examination, investigations
- Immediate treatment — supportive, specific, disposition

Overview

This young man has life-threatening envenomation, most likely from a brown snake (*Pseudonaja* spp.) bite. He requires simultaneous resuscitation, investigations and definitive therapies.

(a) Initial assessment

History

- How the bite occurred
  - snake seen?
  - snake handled?
  - known snake? (e.g. snake handler)
- Bite
  - number of strikes?
  - puncture marks?
- First aid
  - type?
  - when applied?
  - effective application?
- Symptoms in addition to above
  - blurred/double vision?
  - palpitations?
  - bleeding from bite site or other sites?
  - weakness?
  - respiratory issues?

- Past medical history
  - tetanus status?
  - pre-existing bleeding disorder?
  - past history of bite and/or administration of antivenom?
- Allergies
  - horse serum?

Examination

- General appearance
  - looking well or unwell
  - presence and adequacy of first aid
  - evidence of bleeding from bite site
  - evidence of covert bleeding (e.g. haematemesis/melaena)
- Airway compromise, especially if progressive bulbar palsy or airway bleeding
- Breathing
  - rate/work of breathing/effectiveness
- Circulation
  - pulse rate
  - blood pressure
  - capillary refill
  - overt blood loss
  - dysrhythmias
- Disability
  - eye movements — looking for ptosis and extraocular palsies
  - other localised or generalised weakness

Investigations

- Bedside
  - BSL
  - ECG (for dysrhythmias)
  - bite site swab and urine for venom detection kit (VDK) to guide selection of antivenom
  - urinalysis (for blood/myoglobin)
  - blood for whole blood clotting screen (in plain tube)
- Laboratory — serial tests
  - pCO_2 (venous gas or expired air) for progressive respiratory failure
  - full blood profile (low platelets with DIC, acute anaemia from bleeding)
  - U&Es (signs of renal failure, rhabdomyolysis)
  - CK and LDH (for rhabdomyolysis)
  - coagulation profile (DIC with prolonged PT, aPTT and low fibrinogen)
  - d-dimer/FDP (expect gross elevations)
- Radiology
  - none essential immediately
  - consider mobile chest X-ray if at risk of aspiration
  - consider CT scan of head if suspicious of spontaneous intracranial haemorrhage

(b) Immediate treatment

- Patient is showing signs of envenomation, most likely from the brown snake group (*Pseudonaja* spp.), which would explain his collapse and bleeding.

Supportive

- Move to a resuscitation bay and institute supportive care of ABCs.

Specific

- If compression and immobilisation first aid is not in place or is ineffective, this should be (re)applied.
- Treatment to proceed in conjunction with early consultation of toxicology service.
- Use of antivenom will be determined by clinical status:
  - If clinical examination is consistent with severe envenomation, immediate treatment with polyvalent antivenom may be required.
  - If clinical examination and/or whole blood clotting time are consistent with envenomation, but time is available to perform VDK, wait and use targeted monovalent antivenom.
  - If no clinical evidence of envenomation (unlikely), await formal bloods or development of clinical signs to indicate the need for monovalent antivenom.
  - Administration of antivenom:
    – IV access × 2
    – antivenom (diluted in 1 L normal saline) given by infusion over 30 minutes.
  - Adrenaline available in case of anaphylactic reaction.
  - Give corticosteroid cover if polyvalent or multiple doses of monovalent antivenom are given to reduce the risk of serum sickness.
- Consider use of replacement products of coagulation — FFP, platelets, cryoprecipitate etc. (recent evidence suggests that doing this in addition to supplying one dose of antivenom is adequate for most cases) — in consultation with local toxicology service.

Disposition

- Admit to HDU/ICU for ongoing care.

SAQ 2: resuscitation/surgery

A 45-year-old alcoholic man presents to ED with a two-day history of severe upper abdominal pain. Observations taken at triage are:

T	38°C
HR	120/min
BP	100/80 mmHg
RR	28/min
SaO_2	91% on air

(a) List your differential diagnosis. (50%)
(b) Outline your immediate management. (50%)

Sample answer

Plan

- Overview
- Differential diagnosis — classify anatomically into abdominal versus extra-abdominal causes and rank in order of likelihood
- Immediate management — simultaneous resuscitation (ABCs), investigations, definitive therapies (supportive/specific), disposition

Overview

This is a critically ill alcoholic patient with undifferentiated shock. A broad differential diagnosis must be considered and simultaneous resuscitation, investigations and definitive therapies instituted.

(a) Differential diagnosis

Abdominal causes

- Pancreatitis
- Perforated viscus (e.g. duodenal or gastric ulcer)
- Hepatitis (e.g. alcoholic, infective)
- Acute cholecystitis
- Ascending cholangitis
- Pyelonephritis +/– infected obstructed kidney
- Primary peritonitis (e.g. setting of ascites complicating chronic liver disease)
- Acute appendicitis (e.g. retrocaecal location)
- Ruptured spleen (splenomegaly associated with spontaneous or traumatic rupture)
- Subphrenic collection

Extra-abdominal causes

- Oesophageal perforation (i.e. Boerhaave's syndrome)
- Pneumonia (consider aspiration, as well as typical community acquired pathogens; consider associated lung abscess and empyema)
- Myocardial ischaemia +/– pulmonary oedema
- Pulmonary thromboembolism
- Peri-/myocarditis
- Congestive cardiac failure with hepatic engorgement
- Traumatic pneumothorax (e.g. if a recent fall)
- Cardiomyopathy (e.g. alcoholic, thiamine deficiency-related, ischaemic, hypertensive)

(b) Immediate management

Resuscitate

- Triage
  - ATS 2 to a resuscitation area and commence non-invasive monitoring (NIBP, SaO_2, ECG)
- Airway
  - ensure intact; if not may require definitive airway management
- Breathing
  - exclude immediate life threats (e.g. hypoglycaemia, tension pneumothorax, pericardial tamponade)
  - apply oxygen at 15 L/min via non-rebreather mask
  - consider intubation (e.g. severe type 1 or 2 respiratory failure)
- Circulation
  - large bore IV access × 2 (14/16 G)
  - characterise likely cause(s) of shock clinically (e.g. perfusion of peripheries, JVP)
  - administer IV fluids (e.g. initial bolus of 500 ml normal saline then reassess using endpoint of tissue perfusion — brain, urine, peripheries, as well as HR, BP and JVP)
  - look for evidence of overt/concealed blood loss (e.g. haematemesis/melaena) and treat as appropriate

Investigate

- Perform a history and examination to help produce a likely provisional and differential diagnosis; examine medical record for additional information
- Perform high yield tests
  - Bedside

  - BSL
  - urine dipstick (urinary ketones in alcoholic ketoacidosis; white cells, nitrites, blood in infection)
  - ECG for acute coronary syndrome or pericarditis
  - ABG to ascertain degree of respiratory and metabolic failure
- Laboratory
  - full blood profile (high/low white cells in sepsis, low platelets from hypersplenism or sepsis, anaemia from blood loss; pancytopaenia from alcohol-related marrow suppression)
  - coagulation profile (liver dysfunction)
  - U&Es (renal failure)
  - LFTs (hepatic or obstructive picture)
  - amylase/lipase (pancreatitis)
  - blood, urine, sputum culture
  - serum lactate (correlates with severity of shock, allows progress evaluation)
- Radiology
  - mobile erect chest X-ray (pneumonia, abscess, subphrenic collection, pleural effusions/empyema, cardiogenic/non-cardiogenic pulmonary oedema, mediastinal air, free gas under diaphragm)
  - CT abdomen +/– chest likely to be helpful (once stabilised)

Definitive therapies

- Supportive
  - analgesia (titrated doses of IV morphine)
  - correct severe coagulation disturbances
  - empiric thiamine (prevention of Wernicke's encephalopathy)
  - management of alcohol withdrawal (e.g. diazepam) — commence now to prevent withdrawal on day 2 to 3
  - consider invasive monitoring (CVL/arterial line)
  - sepsis bundle for early goal-directed therapy if severe sepsis (as per Surviving Sepsis Campaign 2008)
  - communicate with patient/family
- Specific — will depend on diagnosis, e.g.
  - pneumonia — antibiotics
  - pancreatitis — supportive initially
  - cholecystitis — antibiotics initially; possible surgery
  - perforated viscus/abdominal collection/appendicitis — operative, then supportive
  - Boerhaave's syndrome — antibiotics then stenting or surgery
  - myocardial ischaemia — treat as per local acute coronary syndrome guideline
  - upper GI variceal bleeding— octreotide infusion and endoscopic therapy
  - upper GI non-variceal bleeding — high dose PPI then endoscopic therapy

Disposition

- Will require admission under appropriate specialist team
- Will likely require admission to HDU depending on progress
- Social work/alcohol and drugs dependency support if agreeable when improves

SAQ 3: medicine/resuscitation

A 34-year-old man presents to ED 10 days following his second course of chemotherapy for metastatic seminoma. He has been vomiting at home for the past eight hours. At triage his observations are:

T	39.5°C
HR	110/min
BP	65/35 mmHg

Outline your assessment of this man. (100%)

Sample answer

Plan

- Overview
- Assessment
  - history — AMPLE, then more comprehensive when possible
  - examination — ABCs, then head-to-toe examination with assessment of each organ system
  - investigations

Overview

This young man has neutropaenic septic shock until proven otherwise and requires aggressive resuscitation and management. Assessment will occur in concert with these efforts. While he has metastatic disease, long-term remission from this disease process is not uncommon and he is young, so maximal resuscitative attempts should be made in the initial phase, unless/until information is available to the contrary.

Assessment

History

- Sources
  - patient
  - relative/carer
  - medical records
  - GP
  - oncology/urology teams
- AMPLE initially, then more comprehensive when possible
- History of presenting complaint
  - vomiting — frequency; haematemesis or coffee grounds
  - recent pattern of oral intake and urine output (assess accumulated volume deficit)
  - fever history — onset, duration, pattern
- Associated symptoms
  - diarrhoea/melaena/abdominal pain (colitis, gastroenteritis, GI bleeding)
  - URTI symptoms/cough/dyspnoea (respiratory infection, sinusitis)
  - frequency/dysuria/haematuria (UTI)
  - headache/confusion (meningitis/encephalitis)
  - toothache (dental abscess)
  - earache (infection)
  - shoulder tip pain (referred from diaphragmatic irritation)
  - rash (cellulitis, bacteraemia, fungaemia)
- Cancer history
  - previous therapy/timing — surgery, radiotherapy, chemotherapy regimens – recent cell counts and neutropaenia prophylaxis (e.g. G-CSF)

  - antiemetic regimen
  - steroid use (likelihood of deficiency state)
  - bleomycin exposure (need for cautious O_2 therapy)
  - vascular access (e.g. Hickman/Portocath)
- extent of metastatic disease (e.g. adrenal/pericardial involvement)
- current aims of therapy — palliative/curative
- advanced health directive — has DNR been considered/documented?
  - yes → confirm/follow
  - no → full Rx
- patient's (and relatives') level of understanding about short- and long-term prognosis

- Additional history
  - past medical and surgical history (e.g. rheumatic fever increases risk of endocarditis)
  - social history (clarify current supports, smoking, illicit drug and alcohol use)
  - full list of current medications
  - allergies (particularly to antibiotics)

Examination

- General appearance (distress, effort of breathing, conscious state, nutritional status)
- Identify immediate life threats to airway, breathing, circulation
- Vital signs (continuous monitoring of HR/rhythm, BP, RR, SaO_2, T)
- Head-to-toe, looking for a source of sepsis particularly:
  - ENT sources
  - pneumonia
  - colitis (including neutropaenic enteritis or typhlitis)
  - urosepsis
  - meningitis
  - soft-tissue infection
  - central venous access sites/lines
- Features suggestive of additional causes of shock — peripheral perfusion (warm versus cold) and JVP/neck veins
  - more likely:
    - hypovolaemia from vomiting or haemorrhage (low platelets)
    - Addisonian crisis from steroid withdrawal (history)
    - pericardial tamponade from metastatic disease (assess neck veins, heart sounds)
    - pulmonary thromboembolism (look for a limb DVT)
  - less likely:
    - tension pneumothorax (e.g. from recent central line insertion)
    - cardiomyopathy (chemotherapy-induced)
    - anaphylaxis
    - toxicological causes (although depression may have predisposed to an overdose)

Investigations

- Bedside
  - BSL
  - ECG (look for signs of ischaemia/arrhythmia/electrolyte abnormalities)
  - blood gas (type 1 or 2 respiratory failure, acid-base status/Na/K/Cl changes from vomiting, hypoadrenalism, hypoperfusion from shock, renal failure)
  - urine dipstick (signs of infection)

- Laboratory
  - full blood profile (look for neutropaenia, check Hb and platelets)
  - U&Es (look for electrolyte abnormalities including hypercalcaemia and renal impairment, serum glucose)
  - septic screen — blood (peripheral stab and from lines), sputum, urine, skin lesion culture
  - serum lactate correlates with degree of shock
  - consider lumbar puncture (if coagulation and platelets appropriate)
- Radiology
  - chest X-ray (respiratory infection and pattern that may suggest the aetiology)
  - consider CT head if GCS abnormal
  - consider CT abdomen if intra-abdominal pathology suspected

SAQ 4: administration/medical systems

You are the director of a regional ED, and have 10 other district hospitals within a 250 km radius in your region. The CEO of your district has asked you to implement a retrieval service for the surrounding region. You are 400 km from the nearest metropolitan hospital.
Outline your response. (100%)

Sample answer

Plan

- Overview
- Information gathering and stakeholder assessment
- Response

Overview

The prospect of implementing a new retrieval service is exciting; however, extreme caution must be exercised before committing to an undertaking that has major ramifications for many individuals as well as major resource implications. It is prudent to defer immediate decision making in order to undertake a feasibility study and stakeholder analysis. Only then can an appropriate response be provided to the CEO.

Information gathering

- Motivation/triggering events for district CEO — consider personal, medical and political possibilities; explore who else is driving/supporting the proposal
- Need for service
  - patient numbers and predicted acuity/resource utilisation
  - critical incidents
- Availability of alternatives, including the nature and efficacy of existing processes
- Adequacy of current ED staffing
- Projected number of FTEs required for a retrieval service
  - medical
  - nursing
  - administrative
  - pilots
  - road-based transport staff
  - coordination by senior clinician
- Internal resources available/service expansion capacity for retrieved patients
  - ED

- imaging
- pathology
- medical/surgical
- anaesthetic
- intensive care
- nursing
- beds
- other

Response

A formal report should be prepared that encompasses the relevant information above and also:

- Projected costs
  - staff
  - equipment
    - stretcher and bridge
    - portable O_2
    - drugs
    - infusion pumps
    - monitors
    - ventilators
    - defibrillator/pacer
    - communication — phones, radios
- Choice of transport method(s) — procurement and maintenance
  - air — fixed, rotary wing
  - road — existing, new
- Flow-on effects — resources at receiving centre
- Proposed clinical governance, business and management model
- Proposed audit protocols and metrics
  - key performance indicators (KPIs)
  - critical incidents such as prolonged scene time, deaths during transfer
- Proposed staffing model
- Proposed implementation time line and key milestones
- Analysis of possible external funding streams
  - local agencies/organisations (e.g. Rotary/Lions clubs)
- Analysis of external links with services elsewhere (e.g. RFDS, Careflight)
- Summary and recommendations

SAQ 5: paediatrics/anaesthetics

Discuss the use of parenteral agents for procedural sedation of children in ED. (100%)

Sample answer

Plan

- Table 3.3 to assist coverage of pros and cons pertaining to the principal agents — ketamine, propofol, midazolam
- Concluding brief summary of key positive and negative aspects of each drug

TABLE 3.3 Parenteral agents available for procedural sedation of children in ED

Agent	Ketamine	Ketamine	Propofol	Midazolam
Route	Intramuscular	Intravenous	Intravenous	Intravenous
Class	Dissociative anaesthetic	Dissociative anaesthetic	General anaesthetic	Benzodiazepine
Dose	2–4 mg/kg	1–2 mg/kg	0.5–1 mg/kg	0.01–0.1 mg/kg
Onset	Approx. 5 minutes	< 5 minutes	Approx. 1 minute	< 5 minutes
Duration	20–40 minutes	10–20 minutes (but can give repeated boluses)	5–20 minutes (but can give repeated boluses)	10–20 minutes (but can give repeated boluses)
Precautions		• Rapid bolus can cause apnoea	• Often causes apnoea and loss of airway reflexes	• Can cause apnoea and loss of airway reflexes • Can cause paradoxical reactions with agitation
Contraindications	Age < 3/12	Age < 3/12	• Non-fasting • Egg/lecithin/soybean oil allergy	• Previous paradoxical reaction
Side effects	• Vomiting 10% (usually post-procedure) • Hypersalivation (which occasionally results in laryngospasm) • Nystagmus • Ataxia (can persist for an hour or more) • Tachycardia • Hypertension • Dysphoria	• Vomiting 10% (usually post-procedure) • Hypersalivation (which occasionally results in laryngospasm) • Nystagmus • Ataxia (can persist for an hour or more) • Tachycardia • Hypertension • Dysphoria	• Apnoea/hypopnoea • Hypotension • Rarely vomiting • Muscle twitching	• Apnoea/hypopnoea • Hypotension

(Continues)

TABLE 3.3 Parenteral agents available for procedural sedation of children in ED (Continued)

Agent	Ketamine	Ketamine	Propofol	Midazolam
Advantages	• IV access not required • Airway reflexes usually intact • Large toxic/therapeutic window • Relatively safe in non-fasting subject • Amnestic • Analgesic • Effects on seizure threshold debated — possibly proconvulsant	• Able to titrate dosing • Airway reflexes usually intact • Large toxic/therapeutic window • Relatively safe in non-fasting subject • Amnestic • Analgesic • Effects on seizure threshold debated — possibly proconvulsant	• Rapid onset and offset • Provides some muscle relaxation • Amnestic • Effects on seizure threshold debated — most likely anticonvulsant	• Anticonvulsant — safe in epileptics • Amnestic
Disadvantages	• Unable to titrate to response	• Requires IV access (often with topical analgesia prior) • Debatable need for co-administration of a small dose of benzodiazepine +/– atropine	• Not analgesic • Requires IV access (often with topical analgesia prior) • Pain on injection • Marginally more costly than the other agents	• Not analgesic • Large variation in dose-response and problematic paradoxical reactions

SAQ 6: psychiatry/medicine

A 37-year-old male presents to ED with a two-day history of bizarre behaviour including talking to himself, pacing and not sleeping. His wife is distressed because 'he has never behaved like this before'. He is normally well and works as a computer programmer.

Describe your assessment. (100%)

Sample answer

Plan

- Overview
- Differential diagnosis based on what is known — organic and psychiatric conditions
- Assessment — to differentiate between diagnostic possibilities
  - history
  - examination — ABC, then head-to-toe examination with assessment of each organ system
  - investigations

Overview

This patient has the potential for a life-threatening illness. An organic cause is more likely given his age, but a psychiatric disorder is also possible. Assessing him will involve searching for treatable causes while also managing him (and his wife) in a way that does not compromise one or the other's safety.

Differential diagnosis

- Organic
  - systemic disorder (e.g. hypoxia, acidosis, uraemic or hepatic encephalopathy, sepsis)
  - encephalitis (e.g. HSV, HIV, syphilis)
  - brain tumour
  - traumatic brain injury
  - multiple sclerosis
  - epilepsy (e.g. temporal lobe seizures)
  - drug intoxication, withdrawal or side effect (illicit or prescribed)
  - sleep deprivation
  - poisoning (e.g. heavy metals)
  - autoimmune disorder (e.g. SLE)
  - vitamin deficiency (e.g. B_6/B_{12})
  - Wilson's disease
  - normal pressure hydrocephalus
  - porphyria
- Psychiatric
  - mood disorder
  - brief psychotic disorder
  - schizophrenia
  - schizoaffective disorder
  - schizophreniform disorder
  - factitious disorder
  - malingering

Assessment

History

- Sources
  - patient
  - wife
  - other family members
  - work colleagues
  - previous health professionals/medical records
  - mental health teams where he has lived
- History of presenting complaint
  - onset of symptoms — gradual, sudden
  - course of symptoms — fluctuating (? delirium); progressive (evolving disease)
  - any previous similar episodes
  - associated symptoms — full systems review
    - e.g. fever and infective symptoms such as cough, pain, headache, urinary frequency/dysuria, vomiting/diarrhoea, rash, recent oral or genital HSV infection/contacts (infection)
    - e.g. headache, numbness, weakness, head trauma (suggestive of intracranial lesions)
    - e.g. auditory hallucinations (psychiatric problem) versus visual hallucinations (suggestive of organic cause)
- Past medical, surgical, psychiatric history (looking for predisposing factors to the conditions in the differential diagnosis list)
- Medications
  - treatments suggesting a predisposing condition (e.g. steroids, mood stabilisers, anticonvulsants)
- Social history
  - detailed drug and alcohol history; access to intoxicating agent
  - recent personal/work stressors

Examination

- Mental state examination
  - concentrating particularly on safety issues, including violence and suicide risk
  - consider need for/use of restraint (verbal, physical and/or pharmacological) under 'duty of care' until cause clear and appropriate management determined
  - evaluate for mood derangements and perceptual disturbances
- Vital signs (derangements may suggest an organic cause (e.g. fever, hypoxia))
- Full head-to-toe examination (note this may require pharmacological restraint) looking particularly for:
  - asterixis (suggesting hepatic failure/hypercarbia)
  - skin lesions — rash, cellulitis, track marks
  - nuchal rigidity/meningism
  - localising neurological signs
  - hyperreflexia/clonus
  - ocular nerve palsy and/or nystagmus (suggestive of Wernicke's encephalopathy)
  - evidence of pneumonia or intra-abdominal sepsis
  - dehydration
  - toxidromes (mydriasis/miosis, tachy-/bradycardia, sweating/dry skin, increased secretions)

Investigations

- Bedside
  - BSL
  - ECG — looking for ischaemia/arrhythmia/evidence of toxidrome
  - urinalysis — looking for infection
  - consider urine drug screen (a positive result should not dissuade from other potential diagnoses)
- Laboratory
  - full blood profile
    - white cell count (potentially raised in infection; low in malignancy)
    - platelets (low associated with intracranial bleed and contraindicates LP; may be high with inflammation)
  - U&Es — hypo-/hypernatraemia; renal failure
  - Ca^{2+} — elevated level more likely cause than low
  - LFTs — with hepatic failure
  - coagulation profile — abnormal with hepatic failure; associated with intracranial bleeding
  - urine culture — for infection
  - consider if indicated:
    - formal urine drug screen depending on history
    - blood alcohol — only to confirm what has been offered by history
    - cardiac markers
    - lumbar puncture (if any evidence suggesting meningitis/encephalitis)
    - serum vitamin B_6, B_{12}, red cell transketolase (B_1/thiamine deficiency)
    - serum copper and caeruloplasmin (Wilson's disease)
    - ANA, dsDNA titre
- Radiology
  - chest X-ray — for infection/other causes of hypoxia if present, heart failure
  - CT brain — looking for space-occupying lesion, infarct, obvious encephalitis (e.g. HSV involving temporal lobes) — prior to LP
  - MRI — if focal signs and CT non-diagnostic or MS considered
    - likely to be difficult with restless patient
- Other
  - EEG — looking for evidence of seizure activity

SAQ 7: surgery/administration

Write a guideline for the management of patients with suspected renal colic in the Department of Emergency Medicine. (100%)

Sample answer

Plan

- Rationale
- Background knowledge
- Target
- Recommendations
- Investigations
- Special considerations
- Governance issues
- References

Guidelines should be written on DEM letterhead using the standard department format.

Rationale

Suspected renal colic is a common presentation to ED. This protocol aims to improve the flow of patients through the department and serves as a guide for new staff members.

Background knowledge

CT KUB has replaced IVP as the investigation of choice to confirm the presence and precise location of calculi, exclude complications and guide management decisions. Spontaneous passage of a stone depends on the stone's size (e.g. if 4 mm or less, 90% chance; if 5–7 mm, 50% chance; and if > 7 mm, intervention is usually required). Abnormal anatomy will also reduce passage (e.g. ureteral strictures).

Target

All adult patients presenting to ED with a diagnosis of suspected renal colic — a typical history includes unilateral flank pain that may radiate to the groin and genital region, nausea and vomiting, agitation and microscopic haematuria.

Recommendations

Analgesia

- All patients should be given rectal indomethacin unless there is a contraindication. Dose: 100 mg once or twice daily. Patients who weigh less than 60 kg and are older than 60 years should not generally be given more than 100 mg daily.
- Intravenous narcotics can be given at the same time (e.g. morphine titrated to effect).
- Hyoscine-n-butyl bromide helps some patients, but not enough to reliably treat severe pain. Should not be used as sole analgesic agent.

Fluids

Hydration is necessary only for imaging and for the rare patient unable to tolerate oral fluids. Over-aggressive hydration is associated with increased pain from renal distension and urinomas and does not facilitate the passage of stones.

Investigations

First presentation

Perform the following investigations:

- full blood profile, U&Es, calcium, phosphate and urate, urine microscopy and culture
- non-contrast CT KUB
  - patients need a fluid load for optimal imaging and should be sent for imaging with a full bladder. Younger patients can be admitted to DEM overnight for CT in the morning. If CT shows an opaque stone, plain film KUBs can be useful to follow progress.
  - CT is *urgent* in:
    - older patients with a first presentation as a ruptured or rapidly expanding abdominal aortic aneurysm — this is the most serious disorder to rule out; diverticulitis is also common in this group
    - patients with a single kidney
    - patients with infection and suspected obstruction (fever, leukocytosis, pyuria)
- bedside ultrasound may be useful if skilled staff available. Renal distension confirms diagnosis and AAA may be excluded. However, inadequate and/or incomplete imaging limits bedside ultrasound to a quick screening test on first presentations prior to definite CT.

Subsequent presentations

- Repeat blood tests only if indicated (e.g. fever, known or suspected renal impairment).
- All patients should have a urine test sent for m/c/s to exclude pyuria and infection.
- If the presentation is a continuation of a documented episode, there is rarely any need for CT.
- Plain films can assess migration if the stone is radio-opaque.
- Consider ultrasound if a change in the quality or intensity of pain suggests obstruction. This is *not urgent* in the absence of infection.
- Investigation depends on patient-specific factors. A young person should not be subjected to repeat CT scans due to radiation load. Conversely, renal colic cannot be assumed to be the cause of pain in an older patient with a distant history of stones.

Medical expulsive therapy

This term refers to the use of calcium channel blockers, alpha-blockers and steroids that have been shown to increase the rate of spontaneous passage and decrease the duration of pain. All patients should be started on this therapy unless there is a contraindication. It is best to give initial doses in hospital — even for patients going home — because of the incidence of symptomatic palpitations (nifedipine) and hypotension (alpha-blockers, nifedipine).

Disposition

- Admit *if*
  - diagnosis is uncertain — usually to DEM
  - patient requires ongoing parenteral analgesia — once diagnosis is certain, admission should be to urology rather than to DEM
  - infection with obstruction — this means urgent urological referral, intravenous antibiotics and drainage
  - patient has a single kidney with a stone — urgent urological referral

  Strain urine and send stone for analysis.
- Discharge with follow-up
  - uncomplicated renal colic — refer to GP
- Refer to urology as an outpatient if repeated presentations or stones > 5 mm.
- Ensure patient is discharged with adequate analgesia and their imaging is organised.
- Ask patient to strain urine with a tea-strainer at home so the stone can be sent for analysis.

Governance issues

These guidelines were prepared by the DEM Clinical Guidelines Committee <date>.
An audit of compliance with the guidelines will be performed after six months.

References

<list references>
Authorised by <DEM Medical Director>
Review date <typically 2–3 years>

SAQ 8: trauma

A 30-year-old electrician weighing approximately 100 kg presents to ED after a power-board explosion. He has 30% burns to his hands, face, chest and arms. He is awake and alert but in severe pain. He has an area of encircling full-thickness burn to his right arm.

Describe your management. (100%)

Sample answer

Plan

- Overview
- Management — simultaneous resuscitation (ABCDE), investigations and definitive therapies (supportive/specific)

Overview

There is potential for both life and limb threats in this setting. Much will depend on specific history (e.g. an associated fall, loss of consciousness), and assessment and management will occur in parallel. A trauma team should be involved and an EMST/EMSB approach utilised.

Management

Resuscitation

- Primary survey
  - airway
    - intact at present, but potential for deterioration
    - consider early intubation if evidence of airway burns:
      - stridor
      - hoarse voice
      - oedema/carbon-staining of pharynx
      - singed nasal hairs
    - maintain spinal precautions
  - breathing
    - supplemental high-flow oxygen
    - treat tension pneumothorax/haemothorax if present
    - consider supporting ventilation +/– chest wall escharotomy if chest burns are causing respiratory compromise
  - circulation
    - large bore IV access × 2 — preferably through intact skin
  - disability
    - no obvious issues at present
  - exposure
    - keep covered following examination to prevent hypothermia
- Secondary survey
  - head-to-toe examination including back and flanks for obscured burns
  - documentation of burns — area and estimate of depths

Investigations

- Bedside
  - ECG (e.g. hyperkalaemia from deep burns/crush injury, myocardial contusion)

  - ABG (e.g. hypoxia/hypercapnoea from chest injuries, metabolic acidosis suggesting under-resuscitation, high carboxy Hb if accident in enclosed space)
  - dipstick urine (e.g. haematuria +ve in myoglobinuria — will be –ve on microscopy)
- Laboratory
  - full blood profile (e.g. anaemia from blood loss)
  - E/LFTs (e.g. baseline renal function, hyperkalaemia with low Ca^{2+} and high phosphate and CK/LDH in rhabdomyolysis)
  - coagulation profile (baseline)
- Radiology
  - trauma series X-rays (C-spine, chest and pelvis)
  - CT chest/abdomen as clinically indicated

Definitive therapies

- Supportive
  - if not already done, cool burned areas with room-temperature water for 20–30 minutes only (longer can cause/exacerbate hypothermia)
  - administer IV fluids (using Parkland formula)
    - 4 × 30% × body weight (kg) = mL to be infused over 24 h
    - weight = 100 kg = 12,000 mL in first 24 h (half in first 8 h since the burn)
    - + approximately 3 L maintenance fluid
  - monitor progress clinically as well as with urine output (aiming for 1 mL/kg/hr to avoid complications associated with myoglobinuria)
  - pain may be severe — analgesia options include inhaled methoxyflurane/nitrous oxide, titrated IV narcotic, low-dose ketamine as an adjunct
- Specific
  - burns dressing guided by the burns team; cover in clear film initially
  - escharotomy of right upper limb — incisions for this should run through the burned tissue on the medial and lateral borders of the forearm and arm and continue to a depth where the underlying tissue is bleeding (as this indicates living unburned tissue)
  - may require circulatory or other support depending on organs involved
  - may require tissue debridement (e.g. electrical burns with deep necrosis)
  - may require specific management of other traumatic injuries
- Disposition
  - will require admission +/– transfer to a specialised burns unit
  - high likelihood of requiring intensive care management

Key points

- Practise answering SAQs early in your preparation and continue to do so throughout.
- Be acutely aware of time — attempting an answer for *every* question is the key to success.
- Start each answer with a plan. If you are short on time, you may still score marks for this.
- Remember this is a 'short-answer' question. Consider using lists, tables and diagrams where appropriate. Do *not* write an essay.

Chapter 4

Visual-aid questions

A picture paints a thousand words.

Unknown

The visual-aid question (VAQ) section is one of the more challenging components of the exam. Candidates who spend time preparing themselves for this style of examination are more likely to be successful.

Purpose

The aim of this section is to demonstrate candidates' ability in interpreting visual representations as related to emergency medicine. As such, the questions concentrate on items that are important in day-to-day emergency medicine practice. VAQs test not only candidates' ability to interpret visual data, but also their ways of dealing with patients presenting with such problems.

Format

There are eight questions to be answered in one hour, allowing approximately seven and a half minutes to answer each question. In addition, 10 minutes of reading time is allocated at the beginning of the exam during which no writing is permitted.

For visual aids, expect at least one ECG, one laboratory result (often an arterial blood gas and one other item), one plain radiograph (+/– other radiology) and some clinical photos. At least one question will relate to paediatrics and another will relate to trauma. Because VAQs can cover the whole syllabus, anything can be presented. There has been a drift away from using photographs of equipment or therapies in favour of clinical conditions, but *any* clinically relevant photograph could be included.

Each question starts with a 'stem' that provides background information about the case. All the information provided in the stem is important to the case and should be incorporated in your answer. Every word is there for a reason. Read carefully!

The questions may be individual or divided into two or occasionally three parts. Each part is designated a percentage of the total marks — be aware of this when answering the question. You are more likely to score well if you write three pages on the section worth 70% and one page on the section worth 30% than if you do the opposite. In many cases, the first part of the question will ask you to interpret the available data. Include as much relevant and correct information as you can. Even things that may appear self-evident can score points.

The question types can be expected to vary, and trends change and evolve over time. The questions are prepared by the members of the VAQ Subcommittee of the Fellowship Examination Committee. The examiners are assigned questions to mark and so have no prior knowledge of the questions, which ensures that they are not

marking in areas where they are experts. Each question is marked by two examiners who are blinded to each other's marks until they make contact and agree on the final mark.

Preparation

Like much of the fellowship exam, there is a breathtakingly broad range of topics that could be examined in the VAQs. General preparation by methodically working through the full curriculum is important.

Because the questions are prepared by FACEMs, it is reasonable to expect that images will be sourced from the departments they work in. As images and laboratory results become available, the 'bank' of questions will be developed to cover the curriculum. With this in mind and remembering the principle of what is 'common' and 'commonly deadly', it is possible to anticipate the important questions. Table 4.1 outlines likely VAQ topics that require most attention in your preparation. Many of these have featured in previous examinations and are likely to be used again. Other pathologies you need to be familiar with are presented in the right-hand column.

Sample VAQs can be sourced in a number of ways. A small number can be obtained from the College website or your DEMT, or your colleagues can write some for you, but the best way to prepare for this section of the examination is to write some VAQs yourself. We strongly encourage you to work your way through the topics in Table 4.1 to become familiar with the images and/or laboratory results associated with these conditions. The process of identifying suitable material that lends itself well to VAQs is excellent exam preparation.

Google Images (**images.google.com.au**) can help you to easily find images pertaining to virtually any condition — including clinical photographs, radiological images and abnormal ECGs. In addition, excellent collections of thousands of emergency medicine-related clinical photographs, covering all subspecialty areas, are available in atlases such as:

- Knoop K, Stack L, Storrow A. Atlas of Emergency Medicine, 2nd edn. McGraw-Hill Professional, New York, 2002.
- Greenberg M, Hendrickson R, Silverberg M, Campbell C, Morocco A. Greenberg's Text-Atlas of Emergency Medicine. Lippincott, Williams & Wilkins, Baltimore, 2004.

Once you have selected your images and/or laboratory results and made up your questions, spend some time practising writing your answers. Remember to think as the examiners would when considering your responses. The examiners have not selected the questions and do not know the cases themselves, so they do not have any 'hidden agenda' or other special knowledge. You see what they see, so answer as they would, as a 'real' FACEM.

When practising VAQs, it is worthwhile doing them under exam conditions wherever possible. Do at least four in a sitting and include a proportional amount of preparation time (i.e. five minutes' reading time (without writing) for four VAQs). Ask someone to mark them for you —preferably an examiner or DEMT, but otherwise other FACEMs or your study buddies.

As with other sections of the exam, you can incorporate your day-to-day practice into your preparation for the VAQ section. Each time a nurse, medical student, junior doctor or consultant asks you to interpret an ECG, an X-ray or a pathology result or you see a patient where the diagnosis can be made on initial inspection, you have an opportunity to practise your VAQ answering skills.

TABLE 4.1 Common VAQs

Visual aid	Likely VAQ topics	Other VAQ topics

ECGs	• Dysrhythmias
	  • tachycardias — narrow/broad complex (e.g. AF, SVT, VT, torsades, VF)
	  • bradycardias (including heart blocks)
	• Conduction abnormalities (e.g. Wolff-Parkinson-White, Lown-Ganong-Levine, Brugada, prolonged QT syndromes)
	• Acute coronary syndrome
	• Electrolyte abnormalities
	• Toxicology/poisoning
		• Environmental effects — hypothermia
		• Pacemaker failure
		• Low-voltage QRS
		• Electrical alternans (pericardial effusion)
		• Paediatric ECG
		• Normal morphological variants
		• Crossed limb leads

Arterial blood gases	• Respiratory failure (acute, chronic, acute on chronic, hypoxic only, combined hypoxaemic hypercapnoeic) • Metabolic acidosis • Metabolic alkalosis • Mixed respiratory-metabolic patterns (e.g. salicylate toxicity) • Compensated respiratory alkalosis	• Triple disorders • Venous blood gases to monitor acid-base disturbances (e.g. DKA) • Co-oximetry results (e.g. carboxyhaemoglobinaemia, methaemoglobinaemia)

Electrolyte profiles	• Severe hyper- or hypokalaemia
	• Hypo- or hypernatraemia
	• Anion and osmolal gap disorders
	• Hepatobiliary disorders — obstructed and non-obstructed patterns
	• Glycaemic disorders
	  • DKA
	  • hyperosmolar hyperglycaemia
	• Addisonian crisis
	• Starvation
		• Patterns seen in late pregnancy (e.g. HELLP syndrome)
		• Hyper- and hypocalcaemia, albumin corrected or ionised
		• Changes associated with rhabdomyolysis
		• Cushing's syndrome
		• Diabetes insipidus (including head injury)
		• Renal failure (acute, chronic, acute on chronic)
		• Changes associated with normal bone growth in children
		• Changes related to haematological malignancy

Haematology profiles	• Anaemia with MCV interpretation
	  • blood loss
	  • chronic disease
	  • macrocytosis
	• Pancytopaenia
	• Leukopaenia
	• Coagulopathy related to anticoagulation or DIC
	• Isolated thrombocytopaenia (e.g. ITP, post-viral)
		• Normal changes in pregnancy
		• Haemolytic conditions
		• Normal ranges in neonates or children
		• Haematological malignancy — acute blast crisis

(Continues)

TABLE 4.1 Common VAQs (Continued)

Visual aid	Likely VAQ topics	Other VAQ topics
Microbiology results	• CSF — meningitis: viral, bacterial, TB, fungal • Joint aspirate — inflammatory, non-infective, infective, crystal-related • Urinalysis • Urine microscopy	• Preliminary Gram stains on biological specimens • PCR of CSF/urine and their validity • Sputum and endotracheal aspirate analysis • Stool m/c/s and ova, cyst, parasites, C. difficile toxin • Peritoneal and pleural aspirate m/c/s • Cytology for malignancy

Biochemistry results	• Hepatitis results
	  • Hep A
	  • Hep B core and surface Ab/Ag
	  • Hep C
	• Toxicology
	  • paracetamol
	  • lithium
	  • phenytoin
		• Thyroid function tests
		• Iron studies
		  • deficiency
		  • overload (haemochromatosis)

Chest X-rays	• Abnormal placement of ETT, OGT, CVL
	• Consolidation
	• Collapse
	• Effusion
	• Pneumothorax
	• Trauma-related
	  • pneumo/haemothorax
	  • rib fractures
	  • shoulder girdle injuries
	  • subcutaneous emphysema
	  • widened mediastinum
	• Diaphragmatic hernia
	• Hiatus hernia
	• Alveolar infiltrates
	• Interstitial infiltrates
	• Cardiac silhouette alterations
	  • valvular heart disease
	  • cardiomyopathy
	  • chamber dilatation
	• Inhaled foreign body (insp/exp films), especially paediatric
	• Lung abscess
	• Mass lesions
	  • single/multiple
	  • benign/malignant — primary/secondary
		• Subdiaphragmatic gas
		• Hilar lymphadenopathy
		• Prosthetic heart valves
		• TB
		  • primary (including Ghon complex)
		  • secondary
		• Paediatric
		  • normal thymus
		  • dextrocardia
		  • neonatal lung disease
		  • necrotising enterocolitis

Cervical spine images	• Trauma-related
	  • fracture
	  • dislocations/subluxation (uni-/bi-facetal)
	  • atlanto-occipital distraction
	  • atlanto-axial disruption
	  • eponymous fractures (e.g. hangman's, Jefferson's, clay-shoveler's)
	  • flexion/extension views
	  • Swimmer's views
		• Paediatric trauma series — normal developmental variations
		• CT C-spine for trauma including reconstructed views

TABLE 4.1 Common VAQs (Continued)

Visual aid	Likely VAQ topics	Other VAQ topics

Cervical spine images (continued)	• Pre-vertebral soft-tissue abnormalities
	  • foreign bodies (adult — fish/chop bone; paediatric — coins, other objects)
	  • parapharyngeal infection
	  • epiglottitis	

Abdominal X-rays	• Bowel obstruction — small/large • Free gas — under diaphragm/outlining bowel/on decubitus film • Volvulus — sigmoid/caecal • Biliary tree gas • Button battery ingestion (paediatric)	• Hepatic lesions (hydatid cysts) • Ischaemic bowel • Body packers • Intussusception (paediatric)
Limb X-rays	• Paediatric growth plate fractures (Salter–Harris) • Shoulder — dislocations (anterior/posterior/luxatio erecta), may have rib fractures or pneumothorax • Elbow — supracondylar fractures (paediatric) • Forearm — Galleazi/Monteggia fracture dislocations • Wrist — Colles' fracture, scaphoid fracture, (peri)lunate dislocation, avascular necrosis lunate • Hand — mallet finger, game-keeper's fracture, Bennett's fracture • Hip — NOF, dislocation (native or prosthetic), slipped femoral epiphysis (paediatric) • Knee — patella, tibial plateau, proximal fibula fractures • Ankle — malleolar fracture, diastasis of joint, talar fracture, calcaneal fracture • Foot — Lisfranc injury, march fracture, fifth metatarsal fracture	• Pelvic fractures — stable/unstable • Intra-articular fractures • Smith's/Barton's fractures • Non-accidental injury in children • Bilateral posterior shoulder dislocation (electrocution, seizures) • Pathological fractures/cysts • Foreign bodies within joints
CT head scans	• Traumatic haemorrhage e.g. extradural, subdural (acute, chronic, acute on chronic) • Non-traumatic haemorrhage (e.g. intracerebral, subarachnoid haemorrhage) • Intracranial tumour, infarction, abscess, infective collection	• Non-accidental injury with diffuse traumatic changes • Skull X-rays in children • Non-brain injury — facial, orbital, mid-face fractures • Diffuse cerebral abnormality (e.g. cerebral oedema)
CT neck	• Trauma	• Mass lesions
CT thorax	• Trauma • Aortic dissection • Pulmonary embolus	• Mediastinal masses • Hilar lymphadenopathy

(Continues)

TABLE 4.1 Common VAQs (Continued)

Visual aid	Likely VAQ topics	Other VAQ topics
CT abdominal scans	• Traumatic injuries (e.g. ruptured spleen or liver; kidney ruptured, avascular or absent) • AAA • Nephrolithiasis • Acute appendicitis	• Retroperitoneal pathology • Base of lung pathology (e.g. atelectasis, pleural effusions) • Pneumoperitoneum • Inflammatory or ischaemic colitis • Acute or chronic pancreatitis
MRI	• Brain — MS, CT isodense subdural • Spine — MS, abscess, disc protrusion	• Knee — cruciate/meniscus injury
V/Q scan	• PE with segmental defects	
Ultrasound	• Intra-abdominal fluid • AAA	• Pericardial fluid • DVT

Adult clinical images	• Cranial nerve palsies
	• Horner's syndrome
	• Rashes
	• Burns — depth and extent
	• Trauma images
	• Eye disorders
	• Classic facial appearances
	  • Graves disease with proptosis
	  • acromegaly
	  • Cushingoid appearance
	  • Trisomy 21
		• Myaesthenia
		• Hands with joint deformities
		• Wounds/lacerations in specialised areas (e.g. dominant hand, face, lip, eyes, ears)
		• Visible masses (e.g. goitre)
		• Body habitus
		  • hypermobility
		  • Marfan's syndrome
		  • muscular dystrophy
		• Bullous lesions
		• Genital lesions

Paediatric clinical images	• Infectious diseases (e.g. toxic drooling child, meningococcal rash) • Other important rashes (e.g. erythema multiforme, allergic reactions) • Foreign bodies (e.g. aural, nasal) • Traumatic injuries • Nappy rash • Non-accidental injury	• Mucosal conditions (e.g. Kawasaki disease, herpes simplex gingivostomatitis) • Archetypal viral exanthema (e.g. measles, rubella, fifth disease)
Equipment	• Oximeter • Oxylog ventilator • Capnograph waveform • ICC with trochar	• Heimlich valve • Intraosseus access devices • Bougie • Tympanic thermometer
Other images	• Snakes — various types • Spiders — red-back, funnel-web, white-tail	

On the day

Reading time

No writing is allowed during the 10 minutes of reading time prior to the commencement of the exam. Use this time to read through the whole paper *carefully* and plan your overall structure for each question. Decide which questions you are more likely to be able to answer well. It is best to decide *before* the examination whether you will tackle the questions in the order they appear or start 'easy' and finish 'hard'. In either case,

it is imperative you have a good method of timekeeping so that you do not run out of time and miss answering some questions.

Remember, the scoring system rewards consistency over high marks on individual questions — passing only seven of the eight questions will limit your highest possible score to seven, passing only six limits it to six and so on. For this reason, we strongly recommend that you spend an equal amount of time on each question. Extra time spent on a question you are comfortable with may not improve your overall score, but the penalty for not providing an answer to a question is severe! You will score some marks just by taking a logical and systematic approach to your answer.

Answering the questions

Seven and a half minutes is a short time to impart as much information as you know for each question. However, the questions are designed to be answered in this time frame by asking you to address specific issues.

Ensure that you answer the *question that is asked* using the College's glossary of definitions. The wording is deliberately chosen, and details such as age, gender, the specific location of symptoms and whether conditions are isolated or not are all important considerations for your answer. Pay special attention to whether you are asked about 'investigations' or 'management' and so on to ensure you answer appropriately: you will not score points by answering about management when investigations have been requested.

Structure your answers in such a way that they are as easy to understand and provide as much information as possible in a readable and interpretable format. Legibility and rational organisation of your answers cannot be overemphasised. Point-form answers using standard abbreviations are preferred as they allow you to say more and are easier for the examiners to read. Inclusion of tables, flow charts and diagrams is also encouraged, as they can present substantial amounts of information efficiently and in a visual format that makes it easy for the examiners to find the relevant information.

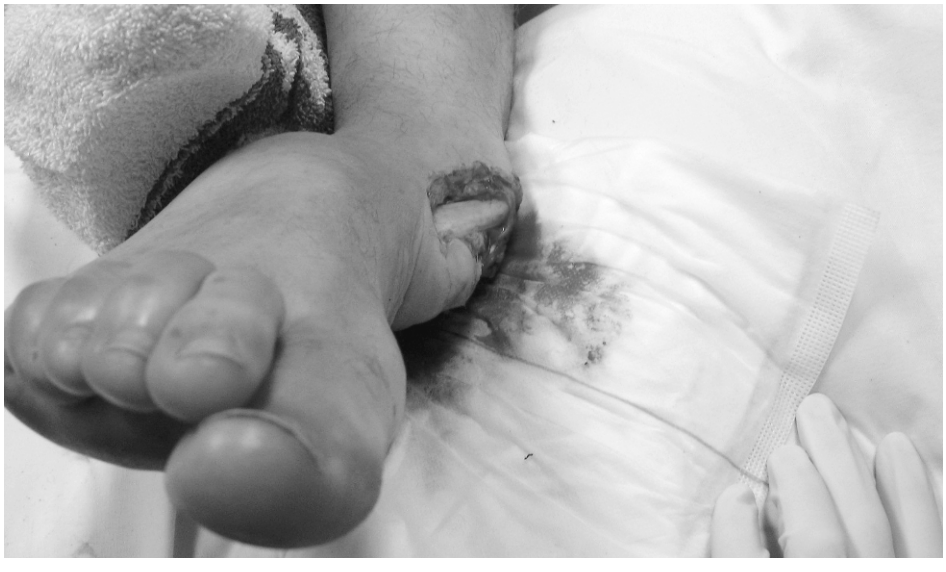
Where appropriate, include a very brief synopsis with headings at the beginning of your answer to remind you of the key elements and to minimise omissions of important information. It is also a good idea to write on every second line, so that you can easily insert any information you recall later.

Use the experience you have gained from sitting practice VAQs. It is not uncommon to have tackled one or more similar VAQs during your preparation. Be aware, however, of subtle differences in the way the questions are asked. The most commonly cited reasons for candidates failing VAQs are failure to answer the question asked and/or providing 'general' answers to a specific question (e.g. discussing general trauma management when told the injury is an isolated one). Answer the question that is asked, not what you would like it to be!

Sample VAQs

To help with your preparation, some worked sample VAQs have been provided. Draw on these as a framework to develop your own practice VAQs, using the topics in Table 4.1 as a guide. In addition, a range of VAQ props are presented as 'problems' for you to ponder with sample questions. We suggest that you use these to develop further questions using standard terminology and then write full answers using the templates suggested in Table 3.2 (see pages 25–27). Suggested answers to some of these questions are provided towards the end of the chapter. A broad range of material is included. Some items are presented to stimulate you to cover topics that may otherwise be glossed over (e.g. therapies and equipment that are now less likely to be assessed as VAQs, but are most easily studied using this format and may be examined in other sections of the exam).

VAQ 1



This image reproduced in the colour section.

A 27-year-old roof tiler is brought to ED by ambulance following a fall from a ladder. After a primary and secondary survey, his only injury is shown in the photo.

Outline your management of this patient. (100%)

Sample answer

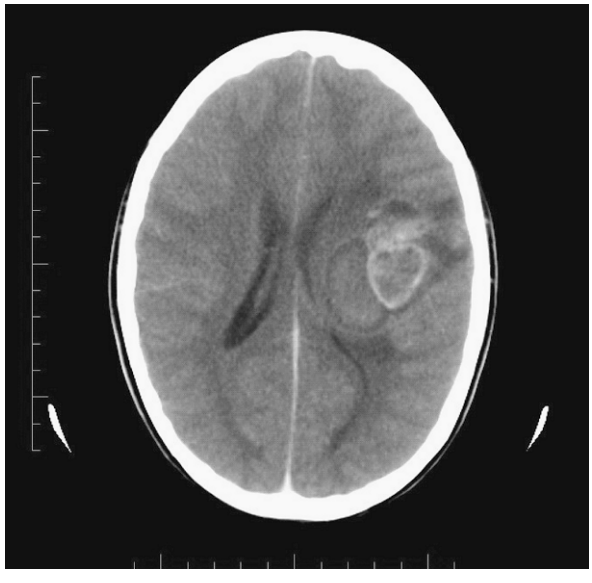
The image shows an open fracture/dislocation of the right ankle.

Management

- Analgesia — options include the following, either alone or in combination:
  - aliquots of IV morphine to obtain adequate analgesia — 1–2 mg every minute until desired result obtained, with observation of other clinical signs
  - inhaled methoxyflurane or nitrous oxide (e.g. Entonox)
  - IV ketamine in 25 mg increments
- Timely reduction of fracture/dislocation, as there is compromise of the circulation.
  - Requires procedural sedation — options include:
    - IV ketamine
    - inhaled methoxyflurane or Entonox
    - IV propofol
  - If possible, obtain image of injury for admitting team to review (if not present).
  - Copiously irrigate wound prior to reduction and remove any visible contamination.
  - Reduce the injury by distraction/disimpaction, increasing deformity and then axial traction.
- Immobilise after reduction in a short leg back-slab with a moist non-adherent dressing covering the wound.
- Perform post-reduction X-ray.
- Administer early prophylactic IV antibiotics to reduce incidence of wound infection (e.g. cephalothin 2 g).

- Tetanus prophylaxis if indicated.
- Disposition — admission under care of orthopaedic team for:
  - elevation of limb
  - probable formal washout of wound in theatre
  - definitive operative management of fracture/dislocation as required
  - ongoing IV antibiotics
  - neurocirculatory observation and possible vascular intervention if required.

VAQ 2



A 10-year-old female presents to a regional ED with a history of increasing headaches over the period of a month and difficulty walking. Observations:

T	36.8°C
P	89/min
GCS	15/15

(a) Describe and interpret this image from her contrast CT brain scan. (50%)
(b) Outline your management priorities. (50%)

Sample answer

(a) Description and interpretation of image

- Description
  - multiloculated ring enhancing lesion in the left temporal region
  - surrounding oedema
  - effacement of ventricle
  - mild midline shift away from lesion
- Interpretation
  - most likely diagnosis — primary brain malignancy
  - differential diagnosis — secondary brain malignancy, abscess, immunosuppressed toxoplasmosis

(b) Management priorities

- Neurosurgical consultation for discussion of immediate options including:

  - steroids — oral or IV dexamethasone
  - seizure prophylaxis — consider loading with phenytoin
  - consider antimicrobial therapy if immunosuppressed or structural heart disease or previous neurosurgical intervention/prosthesis
- Look for other lesions (e.g. tumours, endocarditis causing septic emboli)
- Supportive care
  - definitive airway management if GCS drops
  - check electrolytes, looking for features consistent with central diabetes insipidus, or those associated with repeated vomiting
  - communicate with patient and family
- Disposition
  - arrange urgent review by paediatric neurosurgeon and team
  - arrange safe transfer — will depend on distance and available means

VAQ 3

	Value	Normal range
pH	6.80	7.32–7.43
pCO_2	36 mmHg	37–50 mmHg
pO_2	47 mmHg	36–44 mmHg
Bicarbonate	6 mmol/L	22–28 mmol/L
Base excess	–28 mmol/L	–3 to 3 mmol/L
Sodium	136 mmol/L	134–146 mmol/L
Potassium	6.7 mmol/L	3.4–5.0 mmol/L
Chloride	90 mmol/L	98–108 mmol/L
Urea	13.8 mmol/L	3.0–8.0 mmol/L
Creatinine	210 µmol/L	< 105 µmol/L
Glucose	54.0 mmol/L	3.0–5.4 mmol/L

A 78-year-old woman is brought to ED with a history of increasing confusion over a period of four days. Venous blood gas and U&E results are shown to you by the resident assessing her.

Describe and interpret her listed investigations. (100%)

Sample answer

Listed investigations

Venous blood gas and U&Es show:

- severe raised anion gap metabolic acidosis
- severe hyperkalaemia
- renal impairment
- marked hyperglycaemia
- high calculated osmolality (2(Na + K) + urea + glucose = 353)

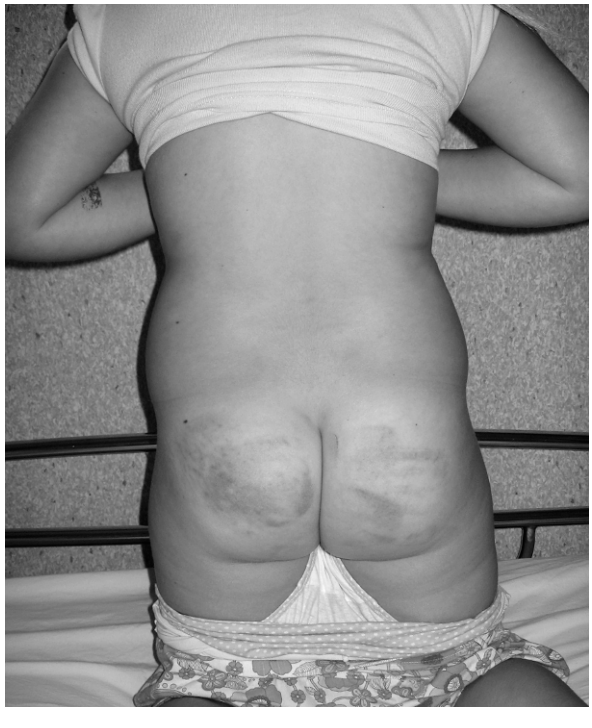
Interpretation

- The most likely principal diagnosis is hyperosmolar hyperglycaemic state (HHS), formerly known as hyperosmolar non-ketotic diabetic syndrome (HONK).
- This does not explain the severe acidosis, which is usually not a major feature of HHS — possibilities include:

- severe lactic acidosis — along with other causes (e.g. shock, ischaemic bowel), in a type 2 diabetic it could be related to metformin
- diabetic ketoacidosis (DKA) — this is less common in the patient's age group; urinary ketones would be helpful in distinguishing between the two diabetic emergencies — ketones may occur in both conditions, although to a greater degree in DKA
- a mixed picture is possible with tissue hypoperfusion, renal failure and/or sepsis contributing to the acidosis.

- The hyperkalaemia with renal failure will be exacerbated by drugs such as ACE inhibitors, potassium-sparing diuretics and NSAIDs.

VAQ 4



This image reproduced in the colour section.

A 6-year-old girl is referred to ED by her GP with a rash on her buttocks. Outline your assessment. (100%)

Sample answer

An introductory differential diagnosis places the history, examination and investigations into context.

Differential diagnosis

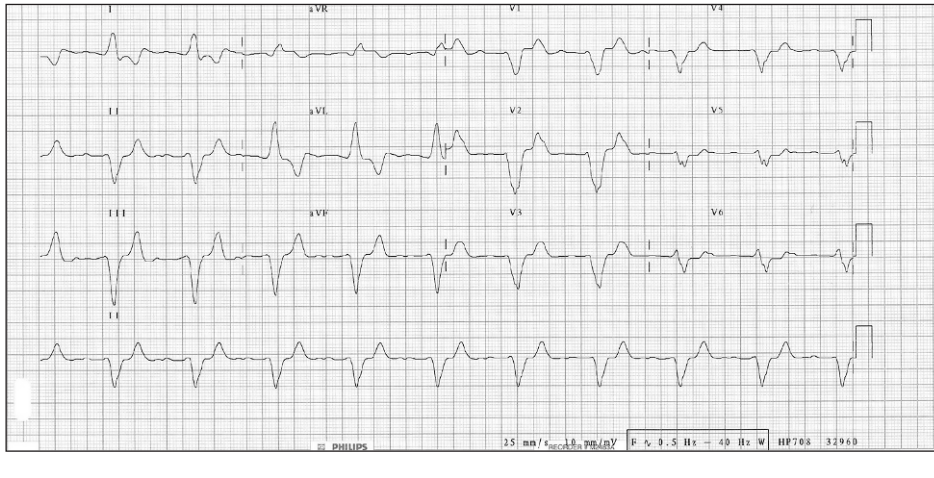
- Henoch-Schönlein purpura (HSP)
- Accidental trauma
- Non-accidental injury
- Drug reaction
- Coagulopathy including ITP
- Bacterial infection including meningococcaemia, endocarditis

History
- Rash elsewhere — including easy bruising/petechiae
- Trauma — if likely, explore for possible non-accidental mechanism
- Fevers — current or recent
- Recent infections (respiratory, non-specific viral symptoms)
- Medications — especially recent and new
- Infectious contacts
- Associated symptoms suggesting HSP — abdominal pain, vomiting, blood in stools, arthralgia/arthritis, haematuria, neurologic symptoms including seizures

Examination
- General assessment — does the child look sick or well?
  - referred by GP and kneeling unaided, so probably well
- Vital signs — temp., pulse, capillary refill time, BP, resp. rate, SaO_2
- Rash — determine whether it is blanching, tender, palpable and present at other locations
- Chest — murmurs suggesting valve disease — signs of pleural effusions or pulmonary haemorrhage — can occur in HSP
- Joint swelling — especially ankles and knees in HSP
- Peripheral oedema — proteinuria
- Abdomen — particularly for tenderness
- Neurologic signs including meningism, abnormal behaviour and conscious state
- Signs of trauma — accidental and non-accidental patterns

Investigations
Will be guided by the above findings. May involve:
- FBC
- U&Es/LFTs
- coag profile
- blood cultures
- urinalysis and microurine if haematuria present
- chest X-ray.

VAQ 5



A 52-year-old woman is brought to ED by ambulance from a nursing home, as she is acting confused. Her medications include perindopril, frusemide, metformin, allopurinol, ibuprofen and Slow K.

(a) Describe and interpret her ECG. (30%)
(b) Outline your pharmacological treatment. (70%)

Sample answer

(a) Description

- Sinus rhythm with a rate just less than 60
- Prolonged PR interval — first-degree heart block
- Broadened QRS complexes
- Peaked T waves
- ST segment changes in most leads

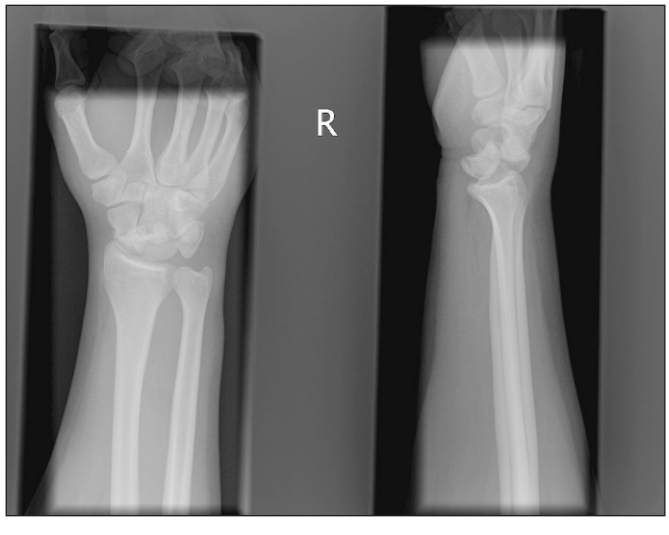
Interpretation

- Consistent with hyperkalaemia

(b) Treatment

- Stop all medications — especially Slow K.
- Stabilise the myocardium — calcium gluconate or chloride 10% 10–20 mL IV (½ dose for chloride).
- Promote intracellular shift of K^+:
  - sodium bicarbonate 8.4% 50 mL IV
  - actrapid 10 IU IV with glucose 50% 50 mL IV
  - consider salbutamol 5–10 mg by continuous nebuliser.
- Remove K^+ from the body — calcium resonium 15 g PO or 30 g PR; consider urgent renal dialysis.

VAQ 6



A 32-year-old man presents to ED after slipping and landing on concrete on his outstretched hand. This is his only injury.

(a) Describe and interpret the X-ray. (30%)
(b) Outline your management. (70%)

Sample answer

(a) Description

- Plain X-ray of right wrist
- Crowded carpal appearance on the PA film with overlap of proximal and distal rows
- Dorsal displacement of the carpi around the lunate, which is tilted but has maintained alignment with the distal radius

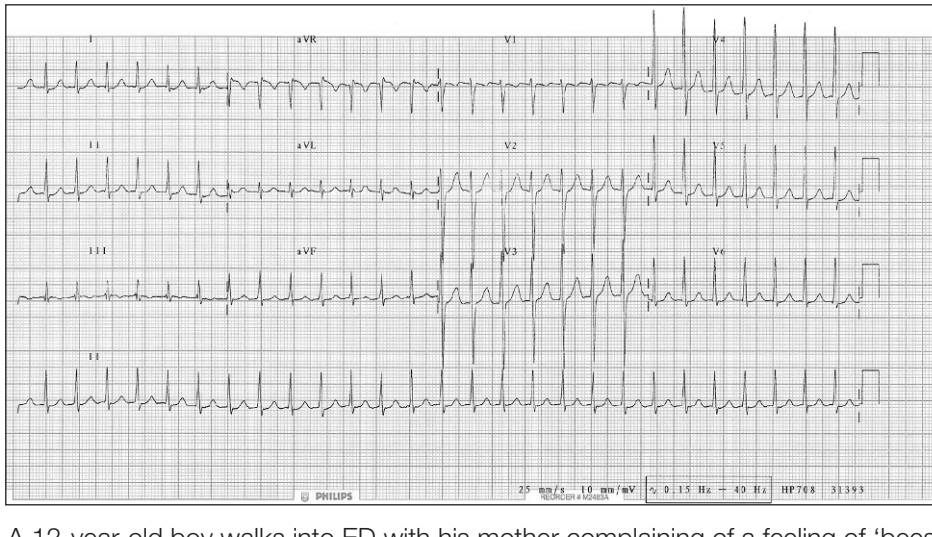
Interpretation

- Perilunate dislocation

(b) Management

- Assess for evidence of median nerve compression — urgent reduction is required if this is present.
- Supportive care:
  - analgesia options include:
    - oral paracetamol +/– codeine — unlikely to be sufficient
    - inhalational methoxyflurane/nitrous oxide
    - IV titrated morphine
    - consider beginning PCIA
  - dress abrasions if present (unlikely to be compound wound)
  - tetanus prophylaxis if appropriate
  - splinting while awaiting definitive treatment.
- Definitive treatment and disposition:
  - early orthopaedic consultation and admission
  - manipulation under anaesthesia then splint
  - consider sick leave/workers compensation certificate if required.

VAQ 7



A 12-year-old boy walks into ED with his mother complaining of a feeling of 'bees buzzing in his chest'. An ECG is performed.

Discuss the treatment options. (100%)

Sample answer

This answer would be well suited to a table, as this enables each option to be discussed in a systematic manner.

Category	Option	Advantages	Disadvantages
Non-pharmacologic: vagal stimulation	Valsalva manoeuvre	• Minimal/no equipment required • Can be taught as a method of termination to patient	• Efficacy related to correct performance
	Carotid sinus massage	• Minimal/no equipment required • Can be taught as a method of termination to patient	• Can cause plaque disruption leading to cerebral ischaemia (unlikely for this patient) • Uncomfortable for patient
	Ice immersion	• Minimal equipment required	• Usually only useful in infants
Pharmacologic	Adenosine	• Rapid if effective • Approximately 90% initial reversion rate • Short half-life	• Contraindicated in certain conditions (e.g. asthma) • Requires proximal IV access • Unpleasant side effects for patient (feeling of impending doom) — must warn about these • Prolonged AV block and transient hypotension may occur • Risk of prolonged asystole and bronchospasm
	Calcium channel blockers (e.g. IV verapamil)	• Approximately 90% initial reversion rate — higher sustained reversion frequency compared with adenosine • Inexpensive	• Side effects — hypotension, headache, flushing • Negative inotrope
	Beta-blockers (e.g. IV metoprolol)	• Lower reversion rate	• Generally longer half-life — associated with longer-lasting side effects including hypotension and bronchospasm

(Continues)

Category	Option	Advantages	Disadvantages
Pharmacologic (continued)	Amiodarone	• Effective for majority of tachydysrhythmias. • Familiar agent in ED with broad therapeutic effectiveness for most tachyarrhythmias	• Prolonged effects may interfere with EP studies • Risk of major side effects including pulmonary fibrosis and thyroid dysfunction
Cardioversion	Synchronised DC shock	• Treatment of choice for haemodynamic instability • Can be considered for all cases but requires assessment of cardioembolic stroke risk with reversion	• Equipment required • Anaesthetic considerations with risks of aspiration if not adequately fasted

VAQ 8

O_2 via nasal cannulae 2 L/min	Value	Reference range
pH	7.13	7.35–7.45
CO_2	7 mmHg	36–45 mmHg
O_2	146 mmHg	8–110 mmHg
Bicarbonate	< 3 mmol/L	21–28 mmol/L
Glucose	15.7 mmol/L	3.0–5.4 mmol/L
Lactate	4.3 mmol/L	< 1.3 mmol/L
Sodium	142 mmol/L	134–146 mmol/L
Potassium	5.2 mmol/L	3.4–5.0 mmol/L
Chloride	103 mmol/L	98–108 mmol/L
Urea	2.4 mmol/L	3.0–8.0 mmol/L
Creatinine	107 µmol/L	< 120 µmol/L

A 39-year-old Indonesian sailor is brought to ED by the ship's first mate with a history of vomiting, visual disturbance and increasing confusion over a period of three days. Some of his investigations, including arterial blood gases, are shown above.

(a) Describe and interpret the investigations shown. (50%)
(b) Outline your further investigations. (50%)

Sample answer

(a) Description

- Metabolic acidosis
- Partial respiratory compensation by hyperventilation
- Elevated anion gap (Na + K) – (Cl + HCO_3) = ~ 41)
- Normal renal function
- Moderately elevated lactate
- Moderate hyperglycaemia

- Calculated osmolality 2(Na + K) + urea + glucose = ~ 312
- Unable to calculate A-a gradient on data supplied — not grossly elevated

Interpretation

The differential diagnosis includes causes of increased anion gap metabolic acidosis with hyperosmolality.

- Most likely:
  - methanol intoxication (fits with the clinical features)
- Less likely:
  - DKA (would expect higher glucose)
  - alcoholic ketoacidosis (would expect normal or low glucose)
  - starvation ketoacidosis (would expect normal or low glucose)
  - salicylate toxicity (would expect hearing rather than visual disturbance)
  - shock e.g. sepsis (visual disturbance less likely)
  - ethylene glycol (would expect renal failure at this stage)
- Unlikely:
  - renal failure (normal renal function)
  - cyanide toxicity (unlikely given time frame)

(b) Further investigations

- Bedside
  - urinalysis for ketones (and calcium oxalate crystals seen with ethylene glycol)
  - check SaO_2 on air and/or repeat ABG on known FiO_2 to detect raised A-a gradient
- Laboratory
  - measured osmolality (to calculate the osmolar gap — expect it to be > 10 mOsm/L)
  - blood alcohol
  - methanol level
  - FBC (? sepsis)
  - serum amylase/lipase (high incidence of pancreatitis with methanol toxicity)
- Radiology
  - chest X-ray to exclude a primary respiratory cause of respiratory alkalosis
  - CT scan of head to exclude a focal process and possible putaminal necrosis with methanol

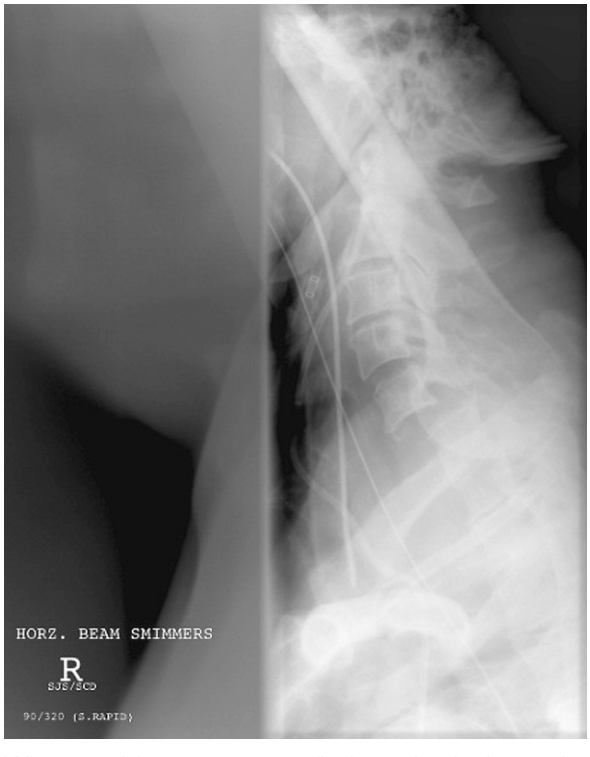
Additional VAQ practice material

The following visual aids are provided for you to interpret. They are deliberately presented in a random order of topics to reflect the exam experience. Try to consider alternative questions for each visual aid using a variety of terms (e.g. describe, outline, list, assessment, management), as this will help you to understand the diversity of ways that images can be used to test your knowledge.

In addition, each visual aid is accompanied by a sample question(s) that you could be asked regarding the image. You may wish to use these sample questions as additional practice; therefore, key elements that would be expected in the answers are provided in the subsequent section.

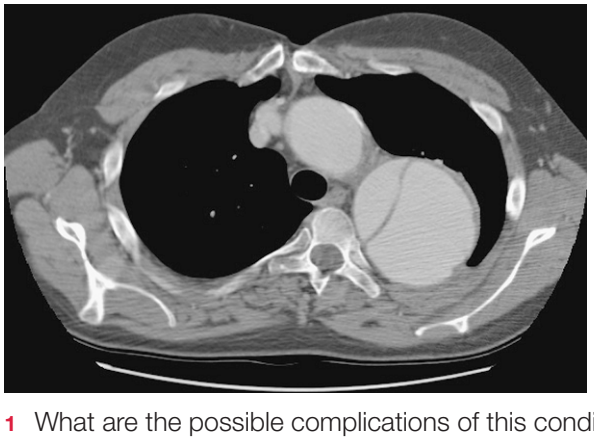
Start by describing the key findings demonstrated by each image, as this is frequently requested in the exam.

Problem 4.1



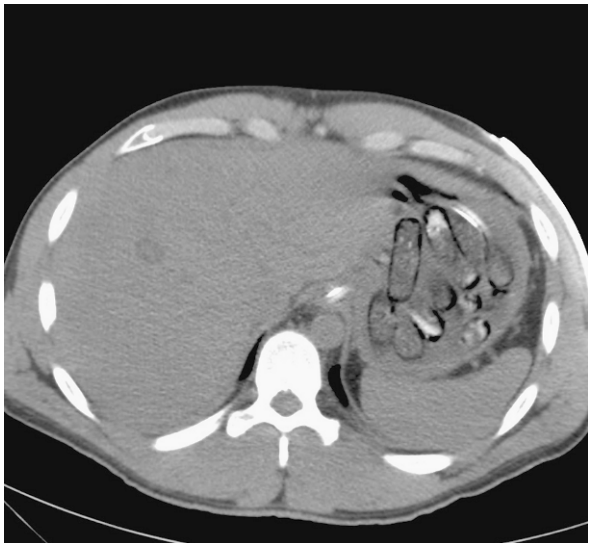
What would you expect to find on physical examination of this patient who was injured today?

Problem 4.2



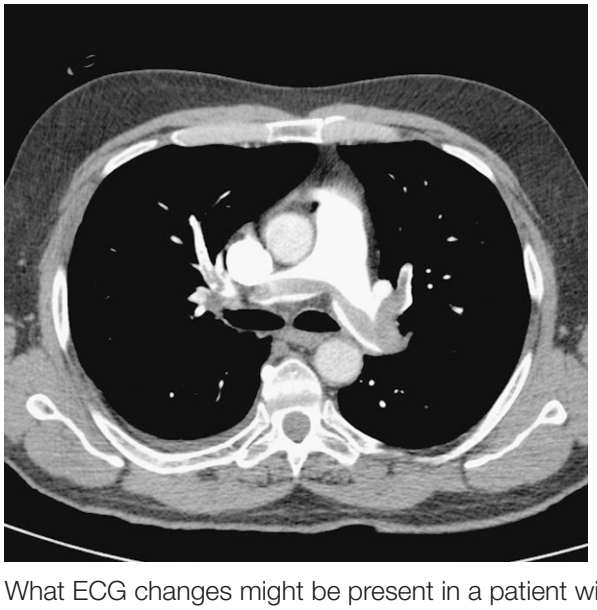
1 What are the possible complications of this condition?
2 What are the principles of managing this condition?

Problem 4.3



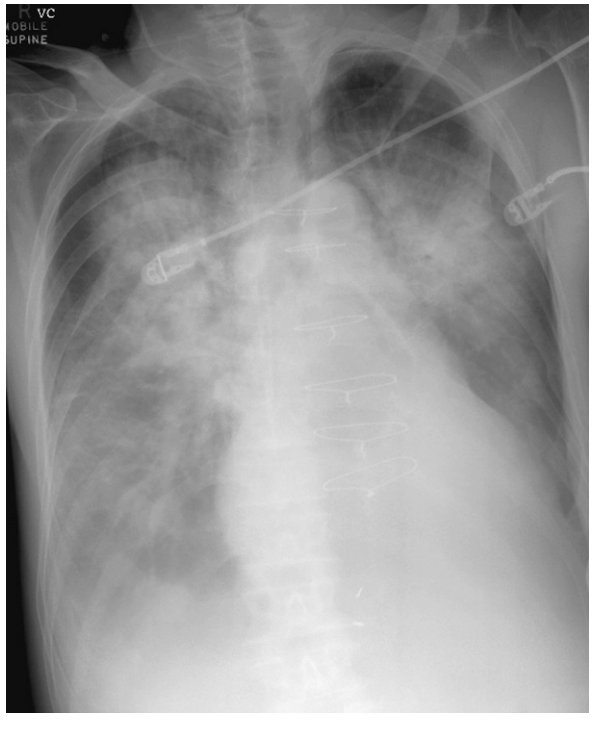
1 Why might this patient have experienced a cardiac arrest?
2 How would you manage an asymptomatic patient with this condition?

Problem 4.4



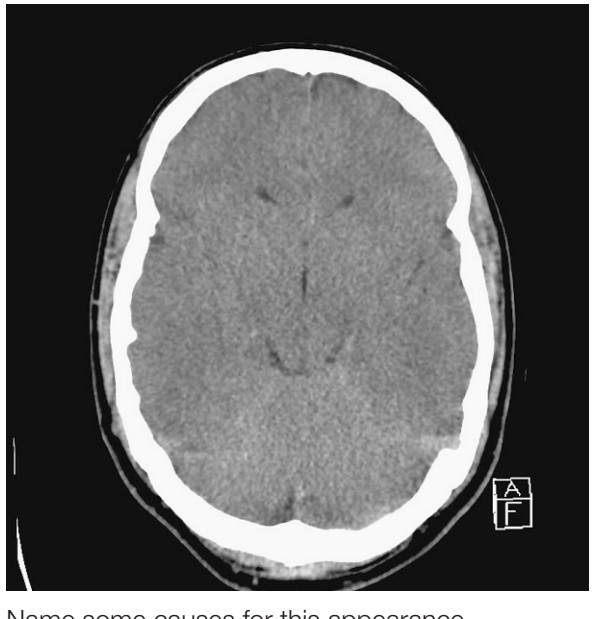
What ECG changes might be present in a patient with this condition?

Problem 4.5



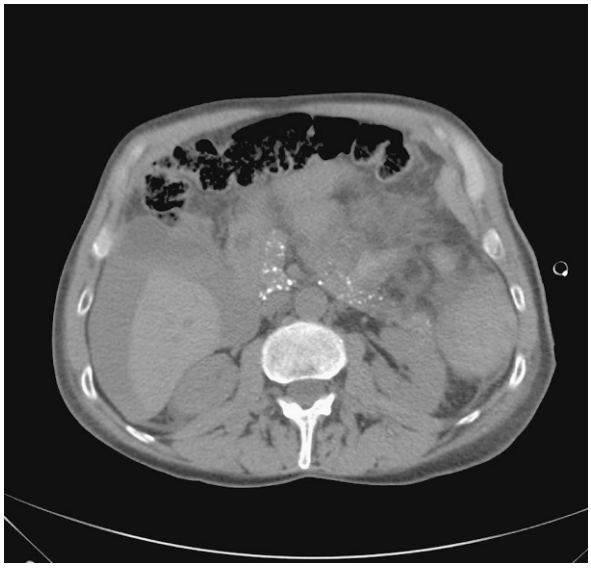
What is your differential diagnosis for this X-ray appearance?

Problem 4.6



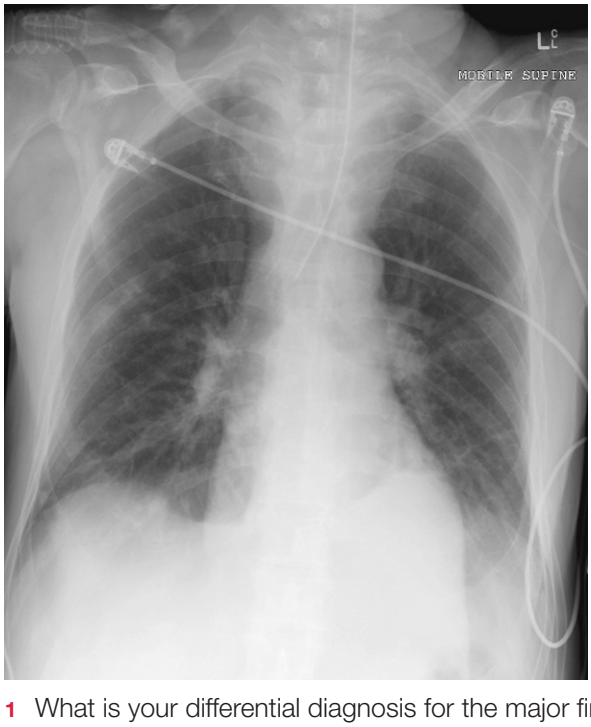
Name some causes for this appearance.

Problem 4.7



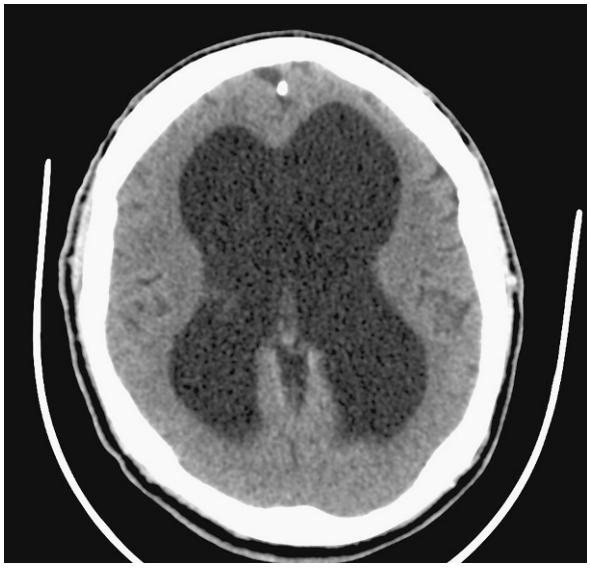
1 How might patients with this condition present to ED?
2 What are the possible underlying causes of this problem?

Problem 4.8



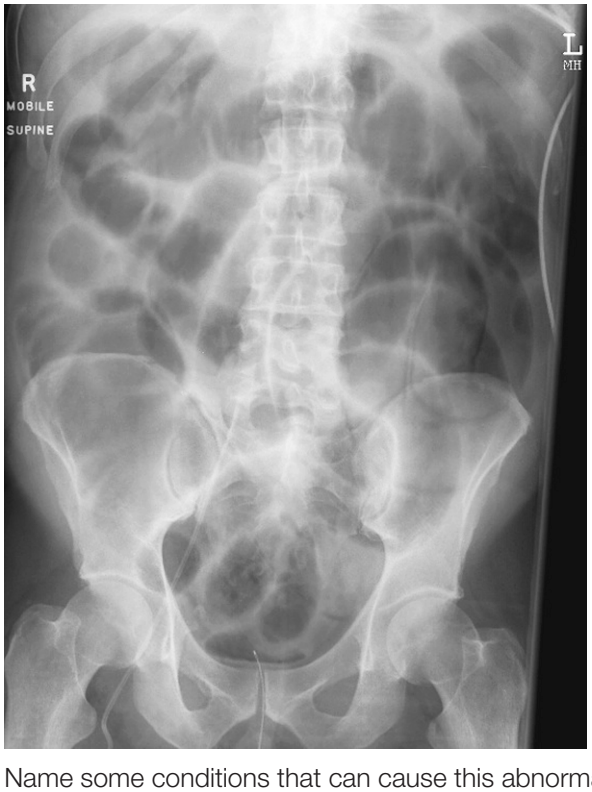
1 What is your differential diagnosis for the major finding?
2 How would you have prepared for intubation of this patient?

Problem 4.9



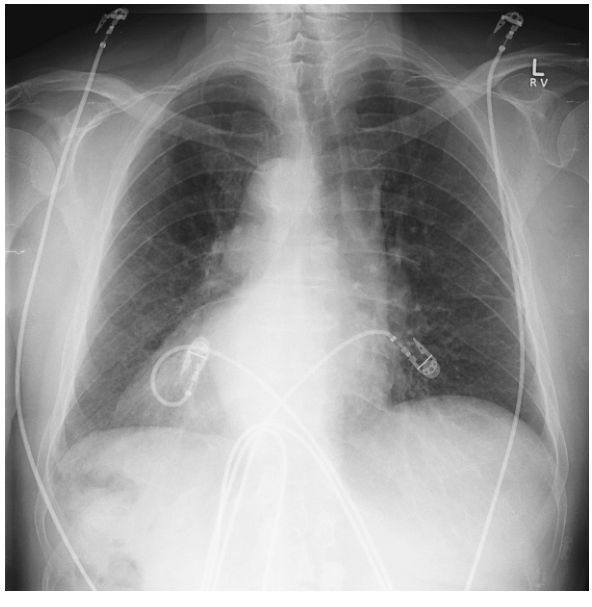
What are the possible causes of this finding?

Problem 4.10



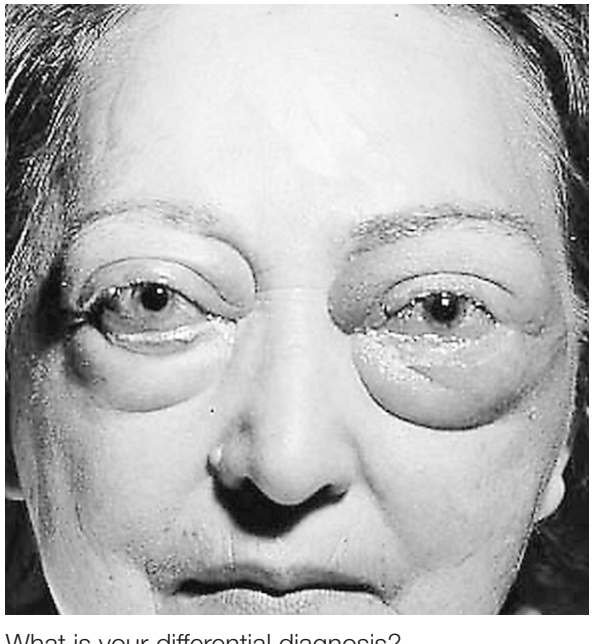
Name some conditions that can cause this abnormality.

Problem 4.11



1 What congenital conditions are associated with the principal finding?
2 What are the implications of this X-ray if you were managing this patient?

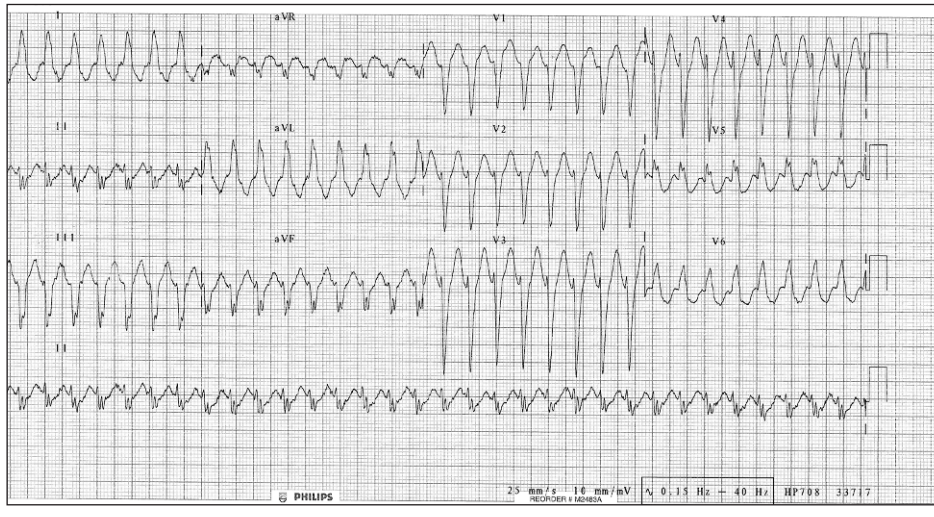
Problem 4.12



Reproduced with permission from the free online endocrinology textbook,www.thyroidmanager.org, version May 2009, edited by Leslie J De Groot, MD.

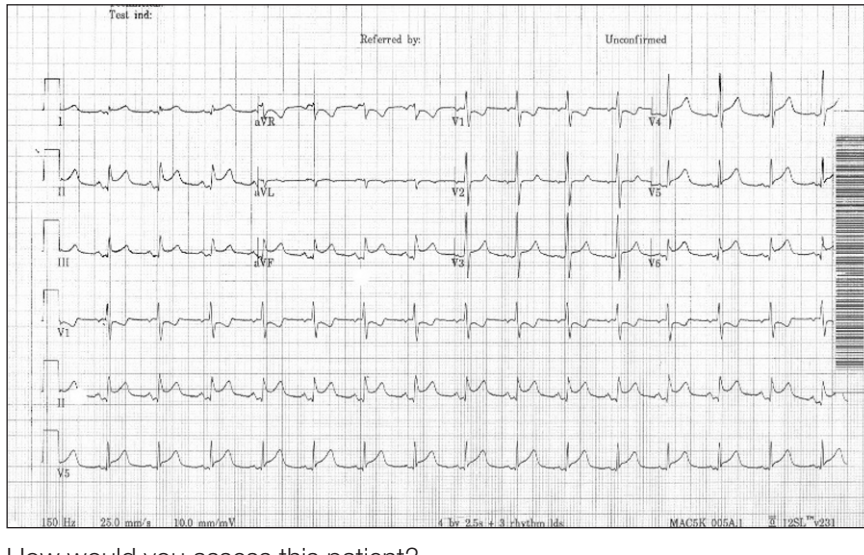
What is your differential diagnosis?

Problem 4.13



1 What is the major differential diagnosis for these changes?
2 How would you differentiate between these two possibilities?

Problem 4.14



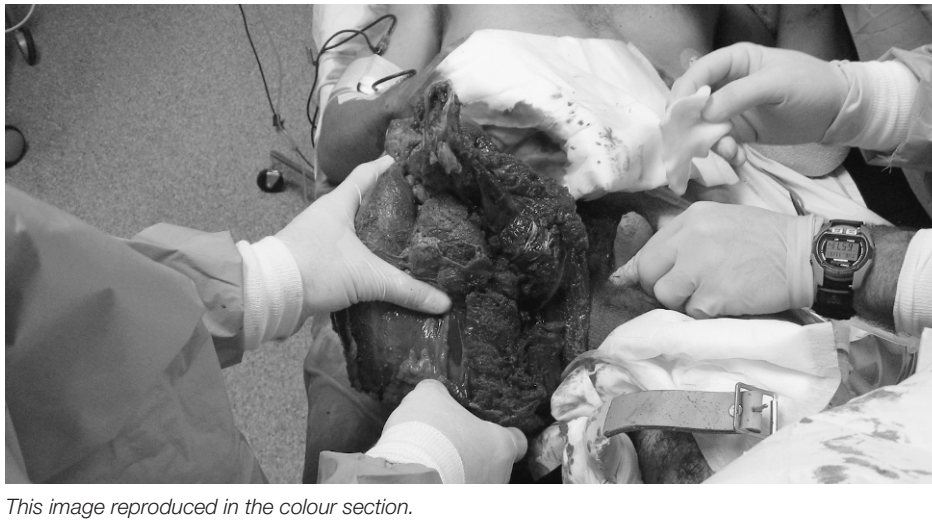
How would you assess this patient?

Problem 4.15

Parameter	Value	Reference range
Sodium	135 mmol/L	135–145 mmol/L
Potassium	6.3 mmol/L	3.5–5 mmol/L
Chloride	96 mmol/L	101–109 mmol/L
Bicarbonate	15 mmol/L	22–32 mmol/L
Urea	19 mmol/L	3–8 mmol/L
Creatinine	79 µmol/L	50–120 µmol/L
Glucose	9 mmol/L	3–7.8 mmol/L
Osmolality	335 mosm/kg	280–290 mosm/kg
Total BR	10 mmol/L	< 20 mmol/L
ALT	38 mmol/L	< 45 mmol/L
AST	450 mmol/L	< 40 mmol/L
GGT	40 mmol/L	< 50 mmol/L
ALK PHOS	85 mmol/L	30–100 mmol/L
CK	50,000 U/L	50–150 U/L
LDH	658 mmol/L	110–250 mmol/L
Corrected calcium	2.1 mmol/L	2.2–2.65 mmol/L
Phosphate	3.01 mmol/L	0.7–1.4 mmol/L

What is the most likely diagnosis? What are the causes of this problem?

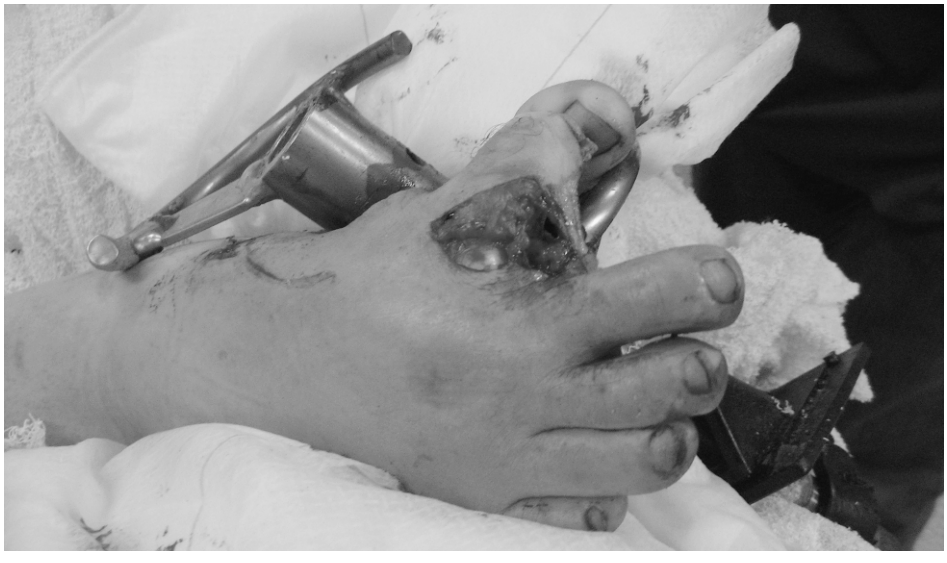
Problem 4.16



This image reproduced in the colour section.

What are the priorities in the management of this farmer who was injured in a tractor accident?

Problem 4.17



This image reproduced in the colour section.

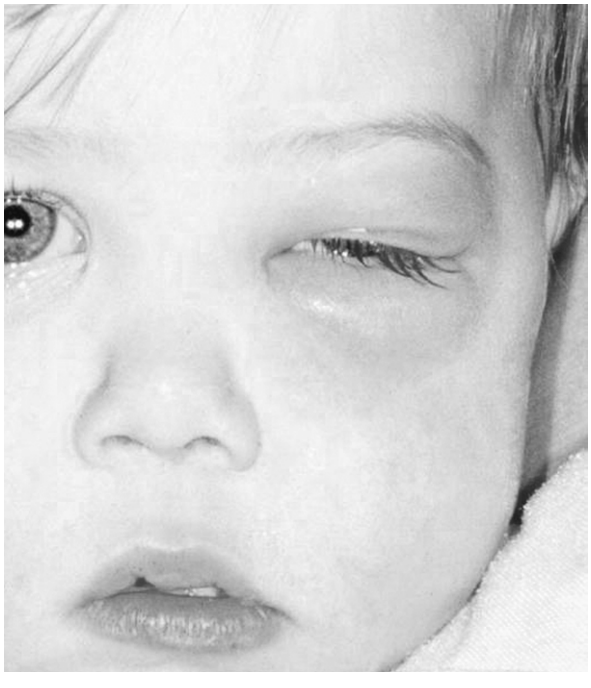
This woman trod on a fertiliser-spreading machine. What are the options for analgesia in ED?

Problem 4.18

Reproduced with permission from the International Centre for Eye Health (ICEH).
This image reproduced in the colour section.

What pathology is demonstrated and how would you manage this patient in ED?

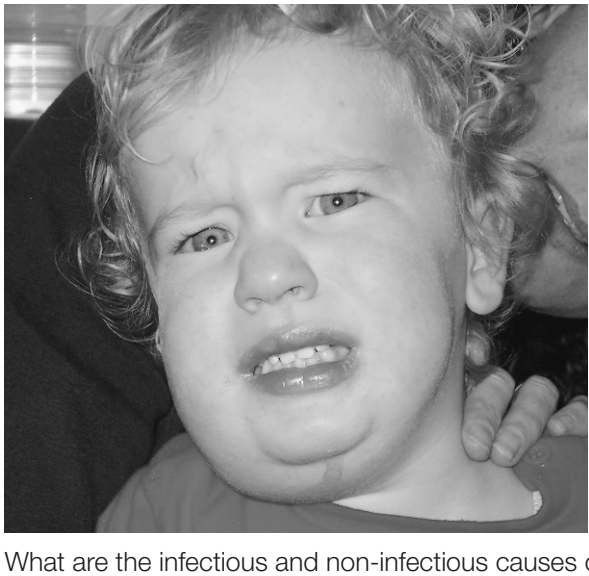
Problem 4.19



This image reproduced in the colour section.

What are the possible causes of this appearance?

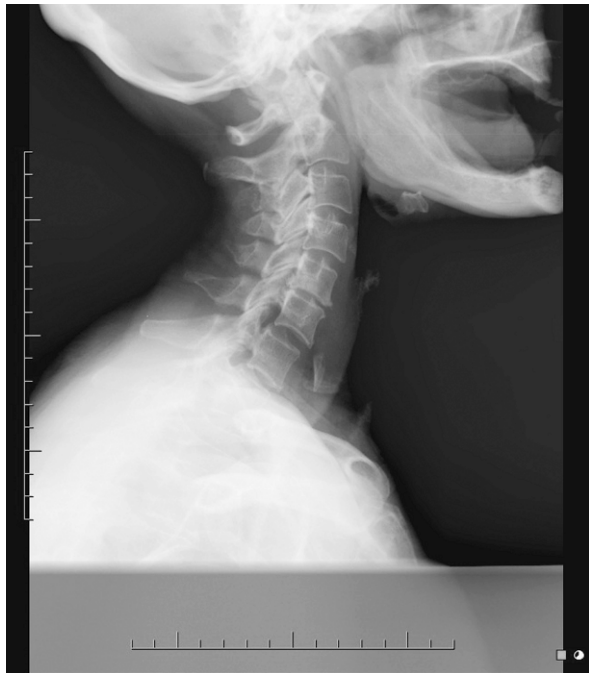
Problem 4.20



This image reproduced in the colour section.

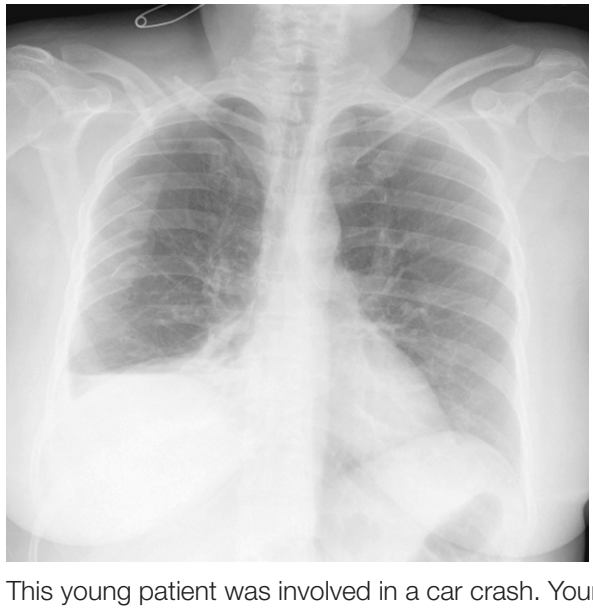
What are the infectious and non-infectious causes of this appearance?

Problem 4.21



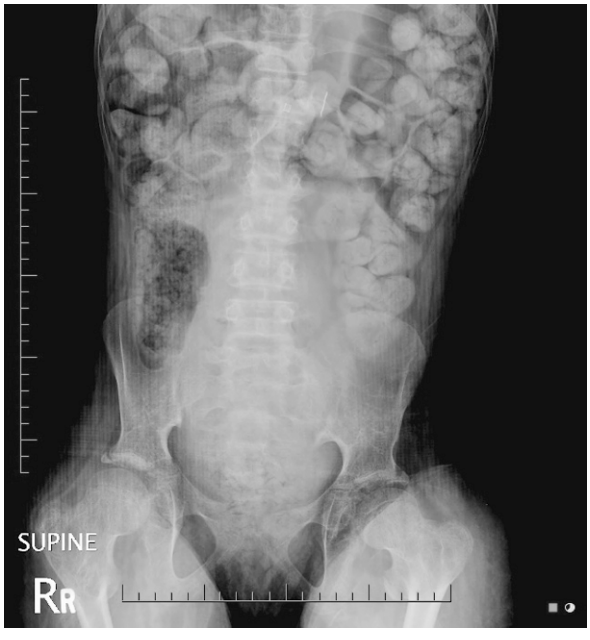
This patient presented with throat pain after eating pork chops for dinner. Describe the X-ray. What are the potential complications of this condition?

Problem 4.22



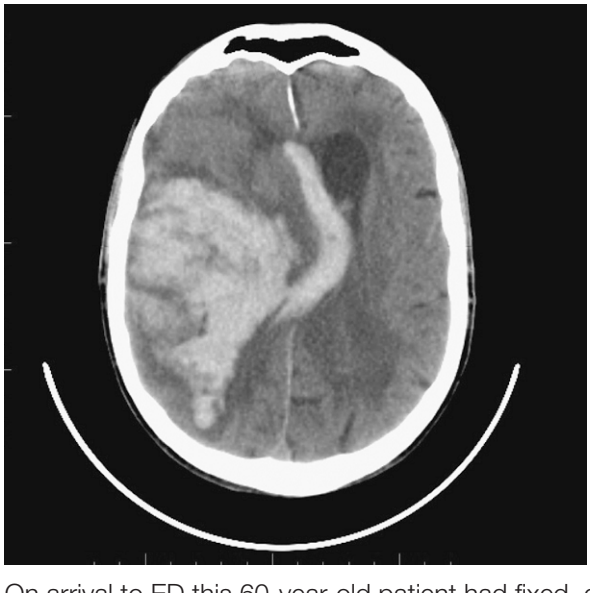
This young patient was involved in a car crash. Your registrar wants to send her home with oral analgesia. How will you manage this situation?

Problem 4.23



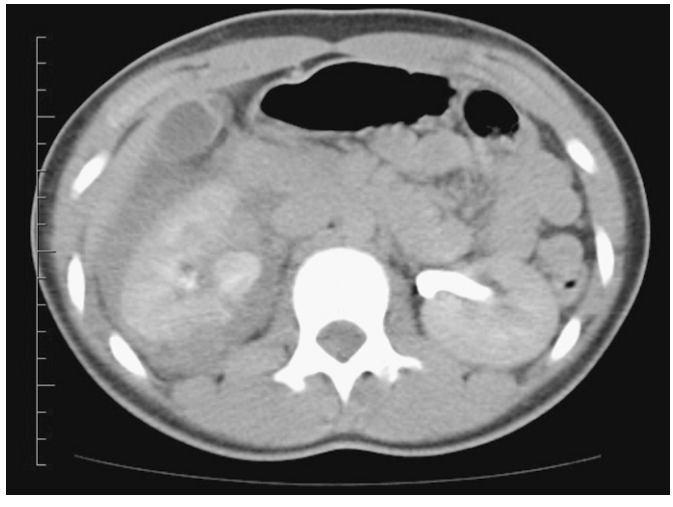
This child presented to ED with abdominal pain. Your intern ordered this X-ray. Should an X-ray be performed to diagnose constipation? Name some important causes of abdominal pain and fever in children.

Problem 4.24



On arrival to ED this 60-year-old patient had fixed, dilated pupils and a GCS of 3. She was intubated for airway protection. She was previously well with treated hypertension. How would you manage her now?

Problem 4.25



Outline the features you could expect to find on examination of a patient with this scan.

Problem 4.26

Parameter	Value	Reference range
Hb	78 g/L	115–160 g/L
RCC	2.23×10^{12}/L	$3.80–4.80 \times 10^{12}$/L
Hct	0.23	0.37–0.47
MCV	102 fL	80–100 fL
MCH	35.2 pg	27.0–32.0 pg
MCHC	347 g/L	320–360 g/L
RDW	20.0	9.0–15.0
White cell count	158.08×10^9/L	$4.00–11.00 \times 10^9$/L
Neutrophils	50.6×10^9/L	$2.00–7.50 \times 10^9$/L
Lymphocytes	4.74×10^9/L	$1.20–4.00 \times 10^9$/L
Monocytes	4.74×10^9/L	$0.20–1.00 \times 10^9$/L
Eosinophils	6.32×10^9/L	$0.00–0.50 \times 10^9$/L
Metamyelocytes	30.0×10^9/L	
Myelocytes	30.0×10^9/L	
Promyelocytes	31.6×10^9/L	
Nucleated RBC	4/100 WBC	
Platelet count	70×10^9/L	$150–400 \times 10^9$/L

1 What is the most likely cause of these abnormalities?
2 What are the complications that this patient might experience?

Problem 4.27

Parameter	Value	Reference range
Hb	59 g/L	110–145 g/L
RCC	1.93×10^{12}/L	$3.90–6.00 \times 10^{12}$/L
Hct	0.16	0.34–0.44
MCV	92 fL	72–87 fL
MCH	30.4 pg	24.0–32.0 pg
MCHC	370 g/L	20–360 g/L
RDW	12.7	9.0–15.0
White cell count	13.70×10^9/L	$5.00–17.00 \times 10^9$/L
Neutrophils	9.62×10^9/L	$1.50–8.50 \times 10^9$/L
Lymphocytes	2.52×10^9/L	$1.50–9.50 \times 10^9$/L
Monocytes	1.32×10^9/L	$0.20–1.00 \times 10^9$/L
Eosinophils	0.19×10^9/L	$0.00–0.80 \times 10^9$/L
Basophils	0.05×10^9/L	$0.00–0.20 \times 10^9$/L
Platelet count	256×10^9/L	$150–400 \times 10^9$/L
Bilirubin	93 µmol/L	< 20 µmol/L

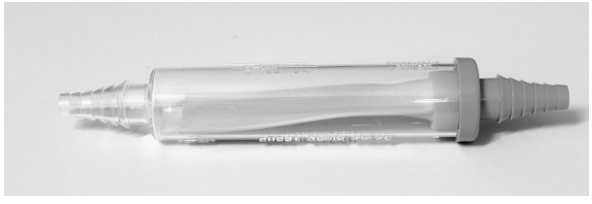
1 What is the most likely diagnosis?
2 What alternative conditions may be present?
3 What additional investigations would help confirm the most likely cause?

Problem 4.28

This image reproduced in the colour section.

What recent research are you aware of that has influenced the use of this agent?

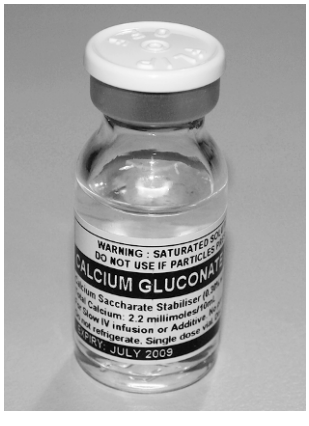
Problem 4.29



This image reproduced in the colour section.

What is the role of this device? How does it work?

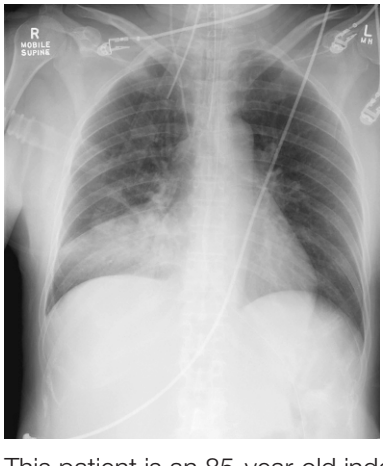
Problem 4.30



This image reproduced in the colour section.

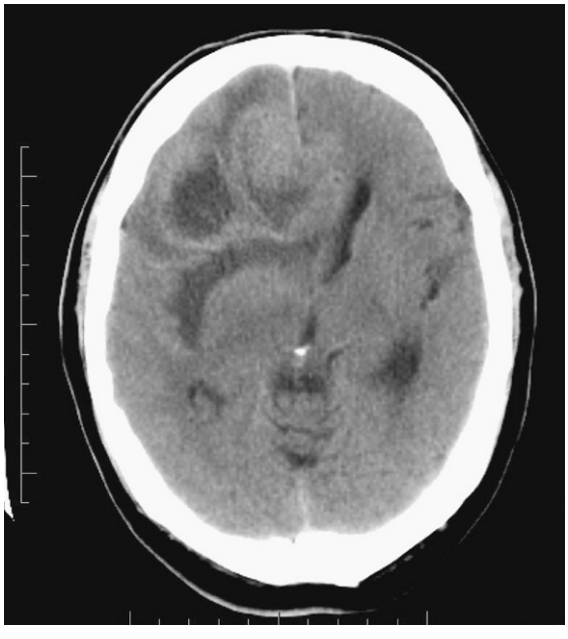
List the potential uses of this agent in ED.

Problem 4.31



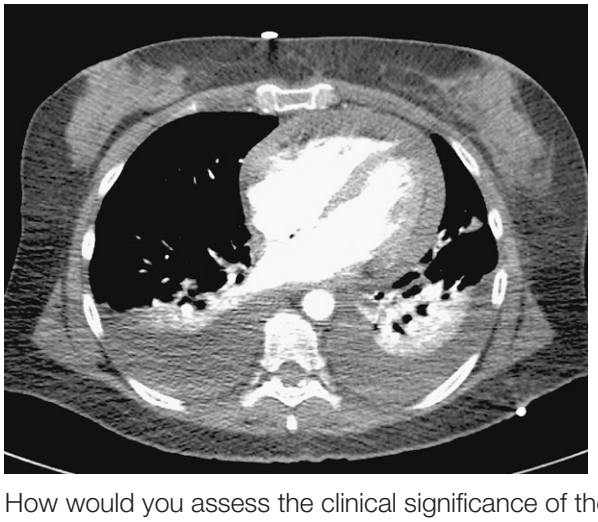
This patient is an 85-year-old independent woman who has had three days of cough and worsening 'breathing difficulty'. She is difficult to rouse. Her vital signs are: HR 110 SR, BP 80/60, RR 30/min, SaO_2 92% with 15 L/min O_2. Outline your management.

Problem 4.32



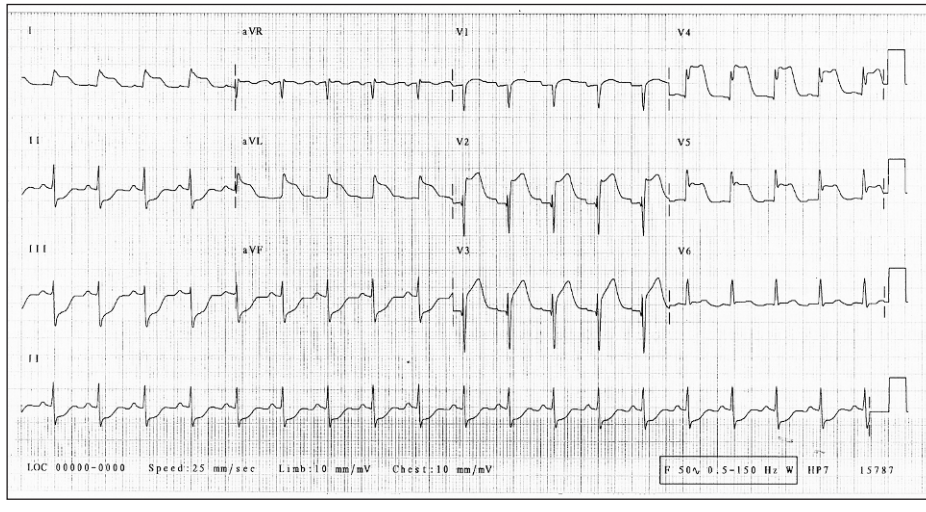
This patient presented with a left hemiparesis and your registrar diagnosed a CVA. He asks you about the indications for thrombolysis in stroke. Describe your response.

Problem 4.33



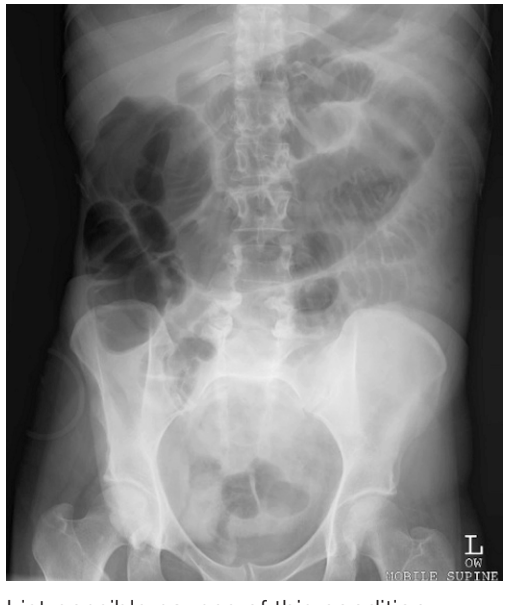
How would you assess the clinical significance of these fluid collections?

Problem 4.34



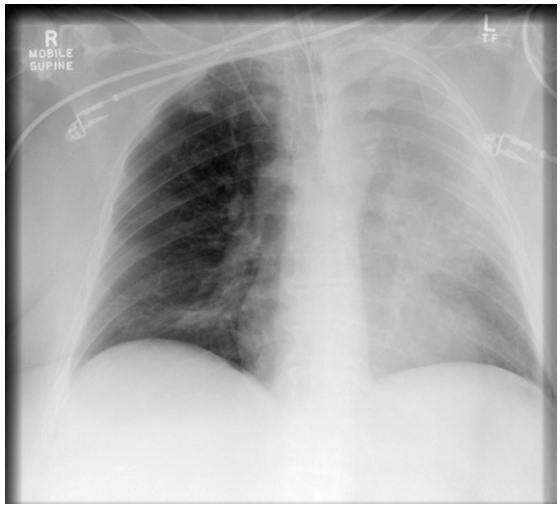
List, and briefly discuss, pharmacological agents that may benefit this patient.

Problem 4.35



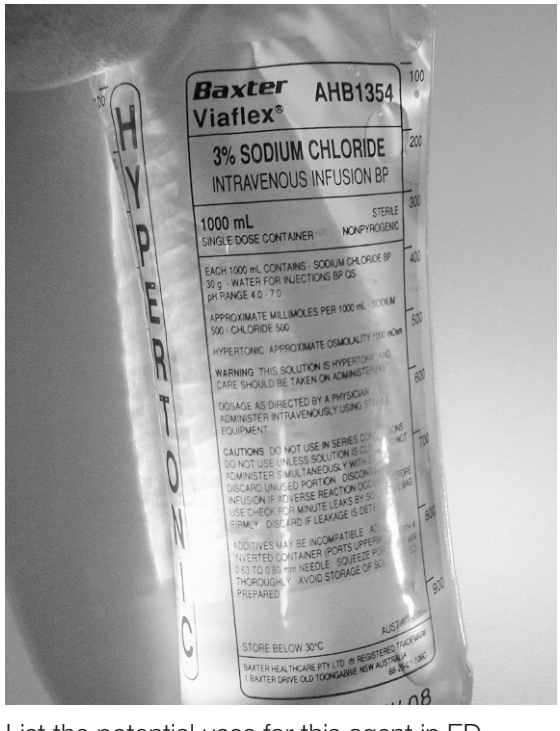
List possible causes of this condition.

Problem 4.36



What procedure would you perform to manage this major pathology evident? How would you perform this?

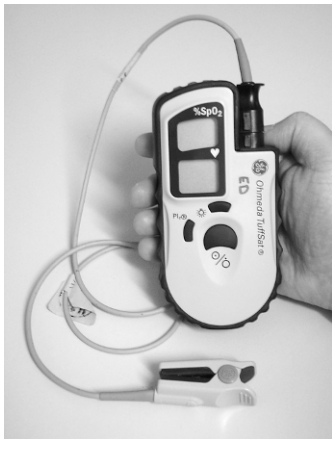
Problem 4.37



This image reproduced in the colour section.

List the potential uses for this agent in ED.

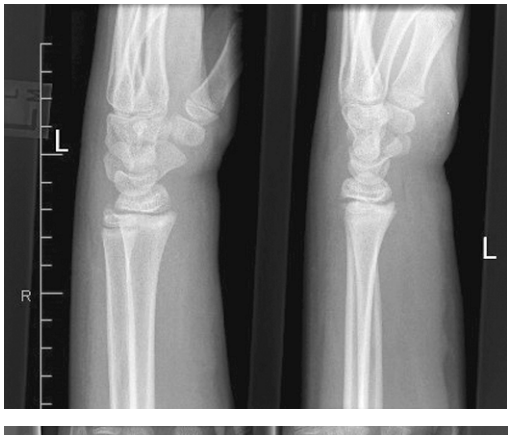
Problem 4.38

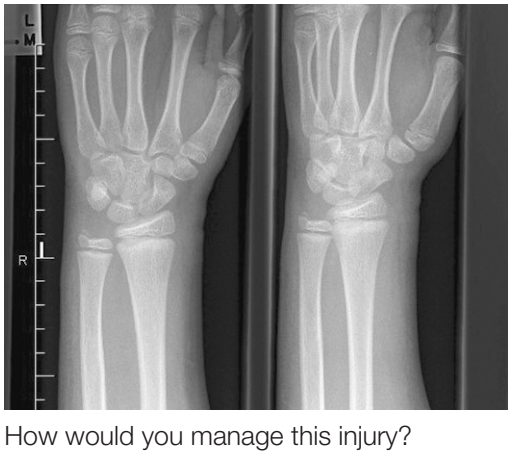


This image reproduced in the colour section.

1 How does this device work?
2 What factors may cause an inaccurate reading?

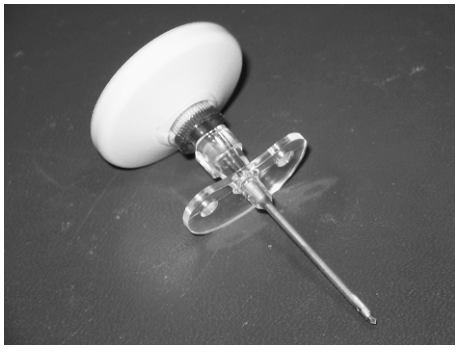
Problem 4.39





How would you manage this injury?

Problem 4.40



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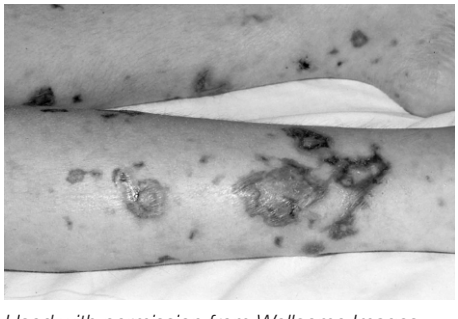
1 What are the indications for use of this device?
2 What are the potential complications?

Problem 4.41



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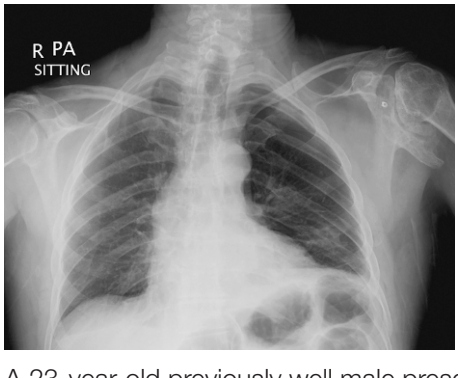
Used with permission from Wellcome Images.

What are the acute management issues associated with this condition in a child?

Problem 4.42



A 23-year-old previously well male presents to ED with a four-hour history of left-sided chest pain and breathlessness on running. Discuss the management options.

Answers to additional VAQs

The following answers outline the key elements that candidates should provide in their responses to the questions posed above. They are not definitive answers, but rather suggest the expected knowledge that candidates should demonstrate concerning each image.

Problem 4.1: horizontal beam Swimmer's view of cervical spine

Key findings

- C5/6 fracture/dislocation with 75% anterior movement of C5 on C6

Expected knowledge

Results of physical examination

- Motor level — motor segments at C6 and below affected — reduced biceps power, absent movement in triceps and loss of all wrist and finger movements, loss of all lower limb power, flaccid tone and absent reflexes in affected muscles including loss of anal tone
- Sensory level — expect loss of sensation below C5 — from below the lateral upper arm
- Spinal shock — vasodilated peripheries despite hypotension, inappropriate bradycardia
- Hypothermia from loss of thermoregulation
- Priapism in a male
- Gastric atony
- Urinary retention
- Phrenic nerve function (C3–5) should be mostly intact, so a normal breathing pattern is retained; however, some people have predominantly C5 innervation to the diaphragm and all injuries are expected to rise one or two levels in the first 24 hours due to oedema, so essential to monitor for complications

Problem 4.2: CT scan of chest with contrast — mediastinal window

Key findings

- Markedly dilated descending aorta with aortic dissection and evidence of flow in a true and false lumen

Expected knowledge

Possible complications

- Aortic wall rupture with haemothorax, hypovolaemia, exsanguination, death
- Vascular occlusion with distal ischaemia/infarction — limbs, gut, brain, kidneys, coronary arteries
- Paralysis if arteries of Adamkiewicz affected
- Acute aortic valvular insufficiency
- Pericardial tamponade
- Superior vena cava syndrome, hoarseness (recurrent laryngeal nerve), Horner's syndrome (cervical sympathetic ganglia), dyspnoea (tracheobronchial), dysphagia (oesophageal) compression from thoracic aortic dilatation

Management principles

- Depends on the type — the simplest approach that also guides treatment is the Stanford Classification:

- type A — involves the ascending aorta — supportive care and surgery
- type B — does not involve the ascending aorta — supportive care only

- Supportive care generally involves analgesia and tight blood pressure control with beta-blockade then vasodilators to reduce wall stress

Problem 4.3: CT scan of abdomen

Key findings

- Multiple abnormal hyperdense foreign bodies in the stomach

Expected knowledge

Possible causes

- The foreign bodies are consistent with the finding of drug packets (classically, latex balloons) used to internally transport illicit drugs, most frequently heroin and cocaine (body packing by 'drug mules'). Both of these agents can cause cardiac arrest in overdose, which can arise when a packet leaks and a drug bolus is systemically absorbed.

Management

- Conservative management with observation is appropriate.
- Interventions, such as surgical enterotomy with 'milking' out of packets, is performed when there is gut obstruction or when a packet leaks and threatens life. Endoscopic retrieval or total gut lavage may also be considered.

Problem 4.4: CT pulmonary angiogram

Key findings

- Linear filling defect in the pulmonary trunk extending into the right and left main pulmonary arteries consistent with a 'saddle' pulmonary embolism

Expected knowledge

ECG changes

- Right heart strain features of $S_1Q_3T_3$ are classic — large S wave in lead I, large Q wave in lead III and inverted T wave in lead III.
- The most common abnormalities in PE are sinus tachycardia, atrial fibrillation (AF), right-axis deviation (RAD) and right bundle branch block (RBBB), although no one or combination of these anticipated ECG changes is reliably diagnostic of PE.

Problem 4.5: mobile supine chest X-ray

Key findings

- Bilateral fluffy alveolar oedema with a peri-hilar predominance — consistent with 'bat's wing' pulmonary oedema

Expected knowledge

Differential diagnosis

The differential diagnosis for alveolar oedema embraces all the types of fluid that may opacify alveolar spaces:

- cardiogenic pulmonary oedema — more common in a patient with sternal wires evident
- non-cardiogenic pulmonary oedema (ARDS)
- infection
- alveolar haemorrhage
- alveolar proteinosis.

Problem 4.6: CT scan of head

Key findings

- Diffuse cerebral oedema as evidenced by loss of grey-white differentiation with no discernible sulci-gyri patterns and obliteration of the ventricular system

Expected knowledge

Possible causes

- Vasogenic oedema — breakdown of blood–brain barrier (e.g. trauma, hypoxia-ischaemia, hypertensive encephalopathy, high altitude)
- Cytotoxic oedema — impaired glial cell membrane pump function (e.g. toxins such as isoniazid, early stroke or hypoxia-ischaemia, Reye's syndrome, severe hypothermia)
- Osmotic oedema — sudden plasma dilution after prolonged generalised hyperosmolality (e.g. during over-rapid correction of hyperglycaemia in hyperosmolar hyperglycaemic state)

Interstitial oedema is unlikely as it is due to CSF–brain barrier breakdown (e.g. obstructive hydrocephalus) and in this case there is no evidence of dilated CSF spaces.

Problem 4.7: CT scan of abdomen

Key findings

- Speckled calcification outlining the pancreas consistent with chronic calcific pancreatitis
- Perihepatic free fluid

Expected knowledge

Presentation

- Persistent abdominal pain
- Steatorrhoea from fat malabsorption
- Weight loss
- Secondary diabetes mellitus

Possible underlying causes

- Chronic alcohol intake (at least 70%)
- Idiopathic (up to 25%)
- Cystic fibrosis (most common cause in young patients)
- Rarely — sphincter of Oddi dysfunction, chronic steroid or anti-inflammatory use, autoimmune

Problem 4.8: mobile supine chest X-ray

Key findings

- Low-lying endotracheal tube
- Widened upper mediastinum

Expected knowledge

Differential diagnosis

- Retrosternal goitre
- Thymoma
- Lymphadenopathy (e.g. lymphoma)
- Lipoma
- Neurogenic tumour (e.g. neurofibroma)

Preparation for intubation

- Describe a sensible preparation for possible difficult intubation, modified by the urgency of the need for intubation, the setting and resources available.
- If trauma-related, anticipate other injuries including volume depletion and other thoracic injuries such as pneumothorax, which will modify drug doses and require careful monitoring for complications.

Problem 4.9: CT scan of head

Key findings

- Marked ventricular dilatation with loss of volume of brain substance consistent with hydrocephalus

Expected knowledge

Possible causes

- In general terms, hydrocephalus is due to impaired CSF flow, impaired CSF reabsorption or excessive CSF production
- Communicating (non-obstructive) — normal-pressure hydrocephalus, hydrocephalus ex vacuo (enlargement of the CSF spaces due to brain atrophy)
- Non-communicating (obstructive) — tumours, haemorrhage, basal meningitis, congenital abnormalities (e.g. spina bifida, Arnold-Chiari or Dandy-Walker malformations)

Problem 4.10: mobile supine abdominal X-ray

Key findings

- Abnormally dilated small and large bowel loops
- Rigler's sign (air on both sides of the bowel wall clearly defining the serosal surface), best seen associated with small loops located near the left iliac crest

Expected knowledge

Conditions that can cause this abnormality

- Perforated abdominal viscus — peptic ulcer, appendicitis, diverticulitis, toxic megacolon, necrotising enterocolitis, neutropaenic colitis (typhlitis), obstructed bowel, anastomotic leak after GI tract surgery, tumours
- Peritoneal dialysis
- Breakdown around an intestinal stoma or PEG tube
- Bronchopleural fistula with extensive air leak
- Rarely in ED — recent laparoscopic surgery with insufflation-related CO_2 pneumoperitoneum; in females, vaginal insufflation (e.g. from water skiing)

Problem 4.11: erect PA chest X-ray

Key findings

- Right-sided cardiac silhouette
- Left hemidiaphragm higher than the right, with gas-filled bowel loops under right hemidiaphragm but not on left side
- Rarely other conditions of the heart, oesophagus and bowel are present

Expected knowledge

Congenital conditions

- Dextrocardia is associated with situs inversus totalis, which is in itself associated with Kartagener's syndrome (immotile cilia syndrome with sinusitis, suppurative lung disease and bronchiectasis).

Management implications
- Need to confirm the X-ray was taken correctly and labelled.
- Need to take a right-sided ECG routinely, place defibrillation paddles on the right, alter anatomical landmarks for pericardiocentesis, expect altered appearances for appropriately situated central lines and consider 'wrong-sided' anatomical differences relevant for predicting injury patterns in injured patients.

Problem 4.12: photograph of eyes

Key findings
- Bilateral periorbital oedema and erythema with pale sclerae

Expected knowledge
Differential diagnosis
- Allergic reaction
- Periorbital cellulitis
- Dermatomyositis
- Cutaneous lupus erythematosus
- Autoimmune thyroid disease
- Relapsing perichondritis

Problem 4.13: ECG

Key findings
- Regular broad complex tachycardia

Expected knowledge
Major differential diagnosis
- Ventricular tachycardia versus SVT with aberrant conduction

Differentiating between the two possibilities
- Provide clinical assessment with ECG analysis.
- Refer to criteria, such as those proposed by Brugada, with a comment that VT would be diagnosed until proven otherwise, particularly in older patients with risk factors for ischaemic heart disease. Brugada J, Mont L, Smeets J, Andries E. A new approach to the differential diagnosis of a regular tachycardia with a wide QRS complex. Circulation 1991; 83:1649–1659.

Problem 4.14: ECG

Key findings
- Sinus rhythm 100/min
- 'Saddle-shaped' ST segment elevation in most leads, especially inferolaterally
- Dominant 'R' in V1/2
- PR segment depression, best seen in inferior leads

Expected knowledge
Assessment
- The major dilemma posed is the diagnosis: pericarditis versus STEMI.
- The history, examination and investigations should be targeted to this crucial diagnostic delineation.

Problem 4.15: serum biochemistry

Key findings
- Hyperkalaemia
- Hyperphosphataemia

- Hypocalcaemia
- High urea:creatinine ratio
- High CK
- Increased LDH and AST

Expected knowledge

Most likely diagnosis

- Rhabdomyolysis

Causes

- Major trauma — crush injury
- Compartment syndromes (e.g. ischaemic limbs, trauma, burns)
- Drugs (e.g. statins, amphetamines)
- Seizures
- Inflammatory myopathies (e.g. viral, autoimmune)
- Thermal injury — hyperthermic syndromes (e.g. NMS, MH, thyroid storm), frostbite
- Sepsis (e.g. necrotising fasciitis)
- Severe hypokalaemia
- Toxins (e.g. snake envenomation)

Problem 4.16: photograph of trauma patient

Key findings

- Traumatic injury involving right lower limb

Expected knowledge

Management priorities

- Use an ATLS/EMST approach with a trauma team if available — a trauma surgeon will be instrumental in definitive management.
- Perform a primary survey to identify and manage immediate life threats — haemorrhage control may be problematic and hypovolaemic shock may require immediate blood product transfusion including O negative blood, if the shock state remains after adequate crystalloid resuscitation.
- Simultaneously insert two large bore IV cannulae.
- Apply pressure dressing to try to achieve stump haemostasis.
- Provide analgesia — titrated narcotic, consider ketamine.
- Perform a trauma series of X-rays — chest X-ray, lateral C-spine, pelvis X-ray (then injured limbs).
- Perform secondary survey with head-to-toe examination.
- Perform ABG — risk of crush injury with rhabdomyolysis (metabolic acidosis, hyperkalaemia, hypocalcaemia), urgent Hb on ABG.
- Send blood tests — urgent cross-match, full blood profile, U&Es, LFTs, CK, coagulation profile.
- Continuous rhythm monitoring and perform 12-lead ECG as risk of hyperkalaemia associated with crush injuries.
- Address tetanus prophylaxis.
- Communicate with patient/family regarding injuries and management plan.
- Commence prophylactic antibiotics (Gram positive, negative, anaerobes).

Problem 4.17: photograph of foot

Key findings

- Open tarsometatarsal dislocations with great toe ischaemia complicating injury from metallic device

Expected knowledge

Options for analgesia in ED

- Inhalational agents — methoxyflurane, nitrous oxide
- IV agents — narcotics (e.g. morphine, fentanyl, tramadol, ketamine with or without midazolam)
- Oral agents — paracetamol alone or a codeine combination, tramadol (unlikely to be of benefit in this case)
- Local anaesthesia — ankle block (e.g. bupivacaine +/– lignocaine injected around the posterior tibial, deep and superficial peroneal and saphenous nerves) after assessment of neurological function

Problem 4.18: photograph of eye

Key findings

- Evidence of a prolapsed iris consistent with a penetrating eye injury

Expected knowledge

Pathology

- There is evidence of a penetrating eye injury with iris prolapse.

Management

- Sit patient upright and keep in a calm environment.
- Use prophylactic anti-emetic.
- Document visual acuity.
- Insert antibiotic eye drops.
- Apply eye shield, *not* pad.
- Undertake urgent ophthalmology review — discuss cycloplegics and prophylactic parenteral antibiotics.
- Address tetanus prophylaxis.
- Consider issue of sympathetic ophthalmoplegia, discuss if appropriate.

Problem 4.19: photograph of child

Key findings

- Left periorbital oedema and erythema

Expected knowledge

Possible causes

- Periorbital cellulitis — clinically important to differentiate between pre- and post-septal
- Orbital cellulitis
- Severe conjunctivitis
- Trauma — accidental, non-accidental
- Dacryocystitis
- Orbital or lacrimal gland tumour

Problem 4.20: photograph of child

Key findings

- Miserable looking child
- Marked swelling of the right side of the face, especially in the submandibular area, with tilting and rotation of the head to the side of the pathology
- Likely cervical/submandibular lymphadenopathy

Expected knowledge

Infectious and non-infectious causes

- Infectious:
  - bacterial — e.g. Group B *Streptococcus*, *Staphylococcus aureus*
  - viral — e.g. EBV, CMV, adenovirus, mumps
  - cat scratch disease — *Bartonella henselae*
  - atypical mycobacterium
  - mycobacterium tuberculosis
  - toxoplasmosis
- Non-infectious:
  - Kawasaki disease
  - malignancy — e.g. lymphoma (Hodgkin's/non-Hodgkin's), leukaemia, solid tumours
  - Langerhan's cell histiocytosis
  - Kikucki-Fujimoto lymphadenitis (histiocytic necrotising lymphadenitis)
  - sarcoidosis
  - SLE

Problem 4.21: lateral X-ray of the soft tissues of the neck

Key findings

- Foreign body consistent with chop bone

Expected knowledge

Description

- Bone-density foreign body present anteriorly at the level of the C6/7 intervertebral disc consistent with chop bone

Potential complications

- Severe pain
- Odynophagia
- Oesophageal perforation
- Mediastinitis and abscess formation
- Empyema
- Aspiration pneumonitis
- Pneumonia
- Septic shock
- Multiple organ failure

Problem 4.22: chest X-ray

Key findings

- Multiple fractured ribs on the right
- Pleural fluid, most likely a haemothorax in a patient with recent chest trauma

Expected knowledge

Management

- Discharge home is inappropriate — high risk of progression to respiratory failure and need for oxygen +/– ventilation. Likely to have a clinical flail segment based on X-ray appearance.
- Management strategies:
  - ensure an ATLS/EMST approach has been taken
  - ensure patient is in a monitored environment — ECG, SaO_2, non-invasive BP
  - ensure patient has oxygen therapy and IV access (send blood for full blood profile, coagulation, U&Es, Group and Hold)

- insert intercostal catheter to drain haemothorax; also possible pneumothorax
- provide analgesia — titrated narcotic analgesia; consider multiple intercostal nerve blocks, intrapleural catheter or thoracic epidural analgesia (discuss with anaesthetist/intensivist/pain team)
- arrange CT scan of abdomen +/– chest (particularly need to exclude liver injury with right-sided rib fractures)
- organise admission to HDU/ICU
- discuss case with/educate registrar
- consider using case for teaching, so others can learn from it
- review department guidelines if systems issue identified.

Problem 4.23: abdominal X-ray

Key findings

- Extensive faecal loading in a child
- Air bronchogram in left lower lobe of lung

Expected knowledge

Role of X-rays in constipation

- The role of X-rays in constipation is controversial. The finding of faecal loading does not correlate with the symptoms and the radiation load is significant, particularly in children.

Causes of abdominal pain and fever

- Mesenteric adenitis
- Acute appendicitis
- Urinary tract infection
- Gastroenteritis
- Henoch-Schönlein purpura
- Pneumonia
- Diabetic ketoacidosis with sepsis

Problem 4.24: CT scan of head

Key findings

- The non-contrast scan shows extensive right-sided intra-cerebral blood with marked midline shift to the left and early hydrocephalus

Expected knowledge

Management

The answer should acknowledge that the prognosis is poor.

- A neurosurgical consultation should be obtained.
- Patient should be admitted to ICU for supportive care.
- Definitive decision making regarding the value of ongoing ventilation would best be done outside ED once key family members have been involved.
- Supportive measures, especially for comfort, which could be undertaken in ED include insertion of a nasogastric tube and urinary catheter, and management of electrolyte and coagulation abnormalities.
- Patient may be a suitable organ donor and this would best be explored in ICU after a period of observation.

Problem 4.25: CT scan of abdomen

Key findings

- The architecture of the right kidney is disrupted with devascularisation and an extensive perinephric haematoma

Expected knowledge

Examination features

- Distressed patient with dull flank pain or pain from other injuries (unless told this is an isolated injury)
- Loin tenderness to palpation or renal 'punch' test (should not use excessive pressure)
- Flank bruising or swelling or loss of a normal flank contour (usually no dramatic external signs)
- Flank mass or ballotable kidney
- Haematuria — macroscopic more than microscopic
- May have significant volume loss — evidence of hypovolaemic shock

Problem 4.26: blood profile

Key findings

- Anaemia with massively elevated white cell numbers, including large numbers of immature forms
- Myeloproliferative disorder in acute transformation

Expected knowledge

Causes

- Myelodysplastic disorder
- Probable transformation from chronic to acute phase

Complications

- Fatigue
- Anorexia, weight loss
- Splenomegaly with abdominal fullness and early satiety; spontaneous rupture
- Hepatomegaly
- Gout from hyperuricaemia
- Hyperviscosity and leukostasis — end organ ischaemia and widespread thromboses may lead to encephalopathy, tinnitus, respiratory distress, priapism
- Low platelets with mucosal bleeding and petechial haemorrhages
- Infections

Problem 4.27: blood profile

Key findings

- Macrocytic anaemia
- Elevated bilirubin

Expected knowledge

Diagnosis

- Haemolysis — evidenced by anaemia with increased bilirubin due to increased cell turnover and macrocytosis, likely due to increased reticulocytes

Alternative conditions

- Differential diagnosis for a macrocytic anaemia:
  - vitamin B_{12}/folate deficiency — folate deficiency may accompany any condition with rapid cell turnover
  - chronic liver disease
  - alcohol abuse
  - severe hypothyroidism

Additional investigations to confirm suspicion of haemolysis

- Morphological blood film examination — polychromasia, anisocytosis and, depending on the cause, schistocytes (fragmented red cells in TTP, HUS, mechanical damage) or spherocytes
- Reticulocyte count — increased
- E/LFTs — renal impairment from haemoglobinuria
- LDH — increased
- Serum haptoglobin — decreased
- Unconjugated bilirubin — increased
- Serum B_{12} and red cell folate — low folate possible; B_{12} generally normal

If additional tests are requested, it is important to comment on what you would expect or hope to exclude.

Problem 4.28: photograph

Key findings

- An ampoule of red-back spider antivenom is shown

Expected knowledge

Recent research

Australian research is evolving in this area and although some studies suggest superiority and safety of IV administration of red-back spider antivenom over the intramuscular route, a recent study has refuted this. Concerns have been raised that antivenom may have little benefit over placebo.

- Isbister G, Brown S, Miller M et al. A randomised controlled trial of intramuscular vs. intravenous antivenom for latrodectism — the RAVE study. QJM. 2008; 101:557–565.
- Ellis R, Sprivulis P, Jelinek G et al. A double-blind, randomized trial of intravenous versus intramuscular antivenom for red-back spider envenoming. Emerg Med Australas. 2005; 17:152–156.

Problem 4.29: photograph

Key findings

- A Heimlich (or flutter) valve is shown

Expected knowledge

Usage

- It is used as a substitute for an underwater seal drainage system during the transport of patients.
- It is most useful for pneumothorax but has limitations for haemothorax — blood may interfere with the function of the valve and it requires a drainage bag attached to the distal end.

Workings

- It is a simple structure composed of a rubber valve compressed at one end to form leaflets, housed within a transparent plastic chamber. One end connects to an intercostal catheter and the other connects to a drainage bag or is vented to air for simple pneumothoraces.
- The valve permits only uni-directional flow of air or secretions on inspiration. On expiration, the negative intrathoracic pressure causes the leaflets to oppose and close, thus no air can flow backwards into the chest.

Problem 4.30: photograph

Key findings

- An ampoule of calcium gluconate is shown

Expected knowledge

Potential uses in ED

- Hyperkalaemia treatment — first line agent to stabilise the myocardium
- Calcium channel and beta-blocker overdose treatment
- Correction of clinically significant hypocalcaemia (e.g. tetany, carpopedal spasms, seizures, long QT/torsades de pointes VT or bleeding with a low ionised calcium)
- Hydrofluoric acid burns treatment (topical gel, infiltration or regional administration — intravenous/intra-arterial, inhalational)
- Magnesium toxicity treatment

Problem 4.31: chest X-ray

Key findings

- Supine mobile chest X-ray
- Right middle lobe consolidation (loss of clarity of right heart border) and collapse (depressed horizontal fissure and loss of volume)

Expected knowledge

Management

- The patient requires resuscitative care, including consideration of early mechanical ventilation if she has reasonable background function and no significant co-morbidities. If she has significant co-morbidities and/or expressed intentions regarding advanced directives, these should be observed if reasonably confirmed.
- The patient is not a candidate for non-invasive ventilation as she is haemodynamically unstable and has a high aspiration risk with altered consciousness level. The evidence for benefit in pneumonia is also equivocal.
- Specific management includes:
  - communicate with family regarding guarded prognosis in view of the patient's age and severity of pneumonia
  - attempt to determine the patient's prior wishes — written or verbalised — regarding advanced directives
  - use intubation and mechanical ventilation if active treatment decided
  - administer antibiotics — she has Class V Pneumonia Severity Index community acquired pneumonia, so requires IV ceftriaxone/cefotaxime 1 g and azithromycin 1 g after blood cultures have been obtained
  - use centrally monitored IV fluid resuscitation and addition of vasopressor therapy if perfusion is fluid-unresponsive
  - administer supportive care (e.g. DVT and stress ulcer prophylaxis)
  - consider nutrition, in conjunction with admitting team.

Problem 4.32: CT scan of head

Key findings

- Contrast scan showing a complex multiloculated lesion with central hypodensity and areas of contrast enhancement
- Extends from the right frontal area across the midline
- Suggestion of ventricular obstruction with a prominent anterior horn of the lateral ventricle

Expected knowledge

Indications for thrombolysis in stroke

- Review the CT and discuss why it is not consistent with an acute ischaemic stroke.
- Discuss the relevant differential diagnosis (e.g. neoplasms such as glioblastoma multiforme or metastatic tumour, cerebral abscess).
- Discuss the indications for thrombolysis (most evidence for IV alteplase) in ischaemic stroke (as an educational exercise, noting it is not a consideration for this patient):
  - presentation within 180 minutes of symptom onset
  - less than ⅓ cerebral involvement
  - ability to give informed consent (no speech centre involvement)
  - visualisation of acute arterial thrombus
  - absence of haemorrhage or a stroke 'mimic' (such as in this case).
- Lytic therapy has only been studied, and proven to be beneficial, in specialised stroke centres with neuro-radiologists and stroke neurologists. The decision is ultimately up to them, with the ED physician's role being early notification of a lysis candidate and use of aspirin within 48 hours.

Problem 4.33: CT scan of chest

Key findings

- Circumferential collection within the pericardial sac
- Bilateral pleural collections of the same-density fluid

Expected knowledge

Clinical significance

- Pericardial effusion, when of a sufficiently large volume, restricts cardiac chamber filling and contraction — termed pericardial tamponade.
- Clinical signs include:
  - low output cardiac state with hypotension and global hypoperfusion (cold peripheries, impaired mentation, oligo-anuria)
  - tachycardia and tachyarrhythmias with low voltage complexes on ECG
  - distended neck veins, muffled heart sounds (completing Beck's triad) and facial congestion
  - dyspnoea
  - tender hepatomegaly (LFTs may show massively increased transaminases)
  - pulsus paradoxus (drop in BP of at least 10 mmHg with inspiration)
  - PEA cardiac arrest
  - ascites and peripheral oedema if a subacute presentation.
- Pleural effusions may be asymptomatic or, if they impair lung expansion, can cause dyspnoea.

Problem 4.34: ECG

Key findings

- Represents an extensive (inferior, anterolateral) acute STEMI, with 4 mm elevation in leads II and III and aVF as well as 10 mm elevation in V2–5
- No Q waves

Expected knowledge

Pharmacological agents that may benefit this patient

- Supplemental O_2
- Nitrates for analgesia
- Titrated IV narcotic for analgesia if nitrates ineffective

- Percutaneous intervention is preferred in any STEMI, but more so if it occurs in an anterior location, even in the absence of cardiogenic shock; if unavailable within 90 minutes, use a plasminogen activator such as IV tenecteplase, which requires an unfractionated heparin bolus/infusion to maintain optimal anticoagulation (within 30 minutes)
- Aspirin 150–300 mg (survival benefit associated)
- Beta-blockers are relatively contraindicated, as there is extensive territorial involvement with a high risk of global ventricular dysfunction; if able to tolerate, decreased incidence of early myocardial rupture/PEA arrest
- On day 2 or later, if haemodynamically stable and renal function satisfactory, consider ACE inhibitor to improve ventricular remodelling
- Start statin therapy and optimise lifestyle and pharmacological management of related diseases such as diabetes mellitus and hypertension

Problem 4.35: abdominal X-ray

Key findings

- Supine film showing loops of dilated small (with plicae circulares) as well as large bowel (with haustrations)
- Although the transverse and ascending colon is particularly obvious, there is gas evident in pelvis that is most likely in the sigmoid colon or rectum
- Suggestive of pseudo-obstruction (ileus) more than mechanical obstruction

Expected knowledge

Possible causes

- Electrolyte abnormalities (e.g. hypercalcaemia, hypokalaemia, hypomagnesaemia, hyponatraemia, hypo-osmolality)
- Drugs (e.g. narcotics, tricyclic antidepressants, antipsychotics, iron supplements, anticholinergics, calcium channel blockers, antacids)
- SIRS
- Neurologic dysfunction (e.g. spinal injury, head injury, diabetes)
- Intra-abdominal inflammation
- Retroperitoneal haematoma
- Hypothyroidism
- Myocardial infarction

Problem 4.36: chest X-ray

Key findings

- Supine film of an intubated patient
- Right-sided central line appears to be higher than optimal
- Veiling opacity of left hemithorax with lung markings still visible — consistent with a large pleural effusion in a supine patient
- Upper and lower mediastinum show no evidence of shift
- It is strictly an inadequate film as the left base is cut off

Expected knowledge

Management

- A small bore catheter could be inserted with a Seldinger technique (e.g. Portex chest drainage kit), or a small to medium-sized intercostal catheter could be inserted with an open technique. It is unclear which approach is superior.

Open technique for inserting a chest drain

- Check coagulation is adequate.

- Select a size 20–26F chest drain.
- Insert into the 'safe' triangle in the axilla (third intercostal space anterior to mid-axillary line).
- Follow aseptic technique — gown, gloves and drape.
- Provide sedation/analgesia.
- Use local anaesthetic infiltration (e.g. 20 mL 1% lignocaine with adrenaline).
- Make skin incision 2 cm over upper edge of lower rib.
- Blunt dissection in layers.
- Check pleural breach confirmed by fluid rush.
- Insert finger and sweep pleura to exclude adhesions.
- Introduce tube without trochar.
- Aim posterobasally for fluid.
- Attach to an underwater seal drainage system.
- Suture with non-absorbable material.
- Apply transparent dressing and secure tubing with a 'mesentery' tape to chest wall.
- Confirm position and response on a chest X-ray.

Problem 4.37: photograph

Key findings

- A bag of hypertonic saline is shown

Expected knowledge

Potential uses in ED

- Correction of severe hyponatraemia with neurologic symptoms (e.g. seizures, depressed consciousness)
- Traumatic brain injury with impending coning (alternative to mannitol)
- Severe tricyclic antidepressant toxicity (some evidence of a role as an adjunct to $NaHCO_3$)
- Management of cerebral oedema complicating paediatric DKA
- Unproven role as a resuscitation fluid in traumatic brain injury or burns
- Possible role as nasal drops in chronic sinusitis

Problem 4.38: photograph

Key findings

- A pulse oximeter with a finger probe is shown

Expected knowledge

How the device works

- Non-invasive method of measuring arterial oxygen saturation based on the Beer-Lambert law = absorbance of light of a given wavelength across a medium is proportional to:
  - concentration of absorbing substance (Beer)
  - path thickness/length (Lambert).
- Probe consists of two light-emitting diodes with a single photodiode to detect emitted light, separated by tissue (e.g. finger).
- Two wavelengths of light are used: red 660 nm (more deoxy Hb absorbed) and infrared 940 nm (more oxy Hb absorbed). Diodes cycle on/off individually with a third phase where both are off (to systematically remove effect of ambient light); cycles are rapid enabling the arterial pulse waveform to be characterised and displayed — the peak of the wave has the most oxy Hb.
- The non-pulsatile absorbance from tissues and extraneous light is subtracted.

- The ratio of absorbed light at 660/940 nm in the pulsatile component of the waveform is converted to a number, the 'SaO_2', using an algorithm.
- Data output is heart rate and haemoglobin percentage oxygen saturation.

Possible causes of inaccurate readings

- Low SaO_2 levels
- Poor pulse/peripheral perfusion
- Excessive motion
- Nail polish (especially blue/purple)
- Thick nails (probe can be turned sideways)
- Optical shunting with poor probe contact
- Abnormal Hb
  - carboxy Hb cannot be differentiated from oxy Hb
  - met Hb — when methaemoglobin levels are excessive, a reading of about 85% is returned
- Increased ambient light
- Severe anaemia
- Dyes (e.g. methylene blue)

Problem 4.39: wrist X-rays

Key findings

- Salter–Harris type II injury of distal radius with 25% dorsal displacement
- Minimally displaced fracture of ulnar styloid

Expected knowledge

Management

- Confirm there are no other injuries.
- Check for and deal with evidence of non-accidental injury, if pattern suggestive (including notification of authorities).
- Provide analgesia:
  - oral analgesia likely to be effective — paracetamol +/– codeine (e.g. Painstop) with an age/weight-appropriate dose
  - splinting to minimise movement
  - consider plaster back-slab while determining disposition.
- Determine need for reduction. Borderline degree of displacement present — discuss with orthopaedic colleagues.
  - If no reduction required:
    - back-slab
    - follow-up in fracture clinic
    - advice sheets — plaster care
    - confirm analgesia available at home.
  - If reduction required:
    - fast for theatre
    - consider sedation for procedure in ED if suitably experienced staff available.

Problem 4.40: photograph

Key findings

- An intraosseus needle is shown — typically inserted in upper tibia or lower femur of children up to about six years of age

Expected knowledge

Indications

- Vascular access when IV not obtainable
- Most useful for children up to six years of age, although may be used in adults (e.g. sternum, ilium, humerus)

Complications

May be classified as local/systemic, early/late, due to device itself/material infused

- Pain (related to insertion)
- Accidental perforation through other cortex
- Inadvertent injury to operator if push through and 'spear' own finger/hand
- Malposition — not in marrow cavity
- Accidental dislodgement once in place
- Local infection — cellulitis, abscess, osteomyelitis
- Fat embolism (rare)
- Pain on injection of fluid from rapid marrow expansion; may also indicate malplacement
- Tissue damage from hyperosmolar fluid (bicarbonate contraindicated)
- Compartment syndrome
- Due to round hand section, device 'points up' when put aside after use, which is associated with an increased risk of staff injury
- Growth plate injury with growth deformity

Problem 4.41: photograph

Key findings

- Child with extensive purpuric rash
- Consistent with meningococcal septicaemia

Expected knowledge

Acute management issues

- Resuscitation — ABCDE, including:
  - definitive airway management if required (hypoxia; decreased LOC)
  - high-flow oxygen
  - IV fluid bolus 20 mL/kg (intraosseous if IV access not possible) — repeat if no response
  - monitor for and correct hypoglycaemia
  - prevent hypothermia
- Investigations, including:
  - full blood profile (for thrombocytopaenia; high or low WCC associated with sepsis)
  - blood cultures — to confirm diagnosis and check sensitivity
  - PCR for *N. meningitides* (most likely), *S. pneumoniae* and *H. influenzae*
- Specific management, including:
  - antibiotics — ceftriaxone 50 mg/kg up to 2 g IV
  - anticipate deterioration within 1–2 hours of administration
  - vasopressor/inotropic support if indicated — high likelihood
  - monitoring: urinary catheter with hourly measure
    +/– central venous pressure
    +/– invasive arterial BP
- Disposition
  - admission to ICU — discuss steroids
  - may require transfer — safety considerations
  - liaison with public health regarding prophylaxis of contacts

Problem 4.42: X-ray

Key findings

- Moderate/large left-sided pneumothorax
  - level of fourth rib posteriorly
- Horizontal line across lower L lung field
  - possible haemopneumothorax (trauma)
  - possible effusion associated with pneumothorax
    - not unexpected with 4-day history
    - consider infection
- Deformed L shoulder with bony changes
  - consistent with past trauma to L shoulder girdle and thorax
- Deformed ribs — L posterior 2, 3, 4 and possibly 5
  - consider acute trauma — rib deformity could be old or new
  - other lung normal, no bullae on either side
- Consistent with pneumothorax — could be spontaneous (if no recent trauma or procedure), trauma- or infection-related

Expected knowledge

Management options

Address the advantages/disadvantages and evidence available related to:

- observation with high-flow oxygen
- needle aspiration
- aspiration using catheter
- small bore intercostal catheter
- large bore intercostal catheter.

Acid-base disorders

This final section is included as a supplementary resource. We hope that you will find this simple, step-wise logical approach as useful as many of our own trainees have found it in the past.

It is almost guaranteed that you will encounter at least one set of blood gas results during your examination. Of course, this is to be expected, as this is also a very regular occurrence in clinical practice. Blood gases are of vital importance to emergency physicians. However, questions concerning blood gas results are often poorly answered in the exam, and many candidates develop a mild respiratory alkalosis from the mere mention of the Siggaard-Andersen nomogram.

The approach to take is as follows:

1 Assess the overall picture.
2 Assess the respiratory and metabolic components individually to decide which is the primary and which is a compensatory effect.
3 Evaluate the degree of compensation to determine the presence of triple disorders and other complex conditions.

Most acid-base disturbances are also associated with respiratory and/or electrolyte disturbances. To assess these, you need to be familiar with calculating A-a gradients, anion gap and calculated osmolality. Some of these have been presented in examples in this chapter.

Terminology

- Acidosis and alkalosis are *processes* defined as having an effect on driving pH down or up, respectively.
- Acidaemia and alkalaemia are *absolute* terms defined as a pH below or above the normal range, respectively.

pH

The distinction between '-aemia' and '-osis' is important, as acid-base analysis commences by observing the pH (acidaemia, alkalaemia or normal). With the exception of a chronic respiratory alkalosis, other primary acid-base disturbances will develop a compensation, which *tends* to normalise the pH but does not compensate completely. For example, the presence of acidaemia (pH < 7.35) indicates the primary disorder is an acidosis and any alkalosis identified will be compensatory.

$PaCO_2$

The $PaCO_2$ reflects the respiratory component. A high $PaCO_2$ is a respiratory acidosis, a low $PaCO_2$ a respiratory alkalosis.

Bicarbonate

The bicarbonate reflects the metabolic component, falling with a metabolic acidosis and rising with a metabolic alkalosis. The *standard bicarbonate* is the bicarbonate when the system is 'standardised', i.e. with a $PaCO_2$ of 40 mmHg and a pH of 7.4. The normal standard bicarbonate is 24.5 mmol/L (usually taken as 24 for ease of calculation — note there is no 'range' as it is 'standardised') and will enable you to quantify the degree of metabolic acidosis or alkalosis.

Similarly, the *base excess* is the amount of base that must be removed (or added) to the system to return it to 'standard' conditions. In practice, the base excess and difference between the measured and standard bicarbonate tend to be similar. If you are brave enough to glance at a Siggaard-Andersen nomogram, you will see the standard bicarbonate is derived from a line drawn across from the $PaCO_2$ of 40 mmHg — as per the definition of standard bicarbonate.

Lactate

Tissue hypoxia results in anaerobic metabolism and lactate production. A high lactate therefore represents a metabolic acidosis with ongoing cellular stress and hence a situation where compensatory mechanisms are inadequate.

Interpretation

By addressing the combined criteria of pH, $PaCO_2$ and any of the metabolic markers, it is possible to rapidly determine the presence of simple or compensated disorders as well as the primary and compensatory components (see Table 4.2). Where both metabolic and respiratory components are driving pH in the same direction, the disorder is termed 'mixed'. The most fascinating case in clinical practice is salicylate toxicity, which can cause all four primary disorders to various degrees.

Acute and chronic compensation

Respiratory compensation

The effect of respiratory alkalosis or acidosis is to change the pH by 0.10 for every 10 mmHg change in $PaCO_2$. Starting from the normal values of pH 7.40 and $PaCO_2$ 40 mmHg, this means the expected $PaCO_2$ will match the pH with the '7' removed. For example, a $PaCO_2$ of 25 mmHg would be anticipated as respiratory compensation for a metabolic acidosis with a pH of 7.25, and a $PaCO_2$ of 50 mmHg would be anticipated with a metabolic alkalosis and a pH of 7.50.

Metabolic compensation

When presented with a primary respiratory disorder, it is possible to determine whether the metabolic compensation is acute or chronic and whether it appears appropriate. Metabolic changes take time to develop and should be to the degree indicated in Table 4.3. When the actual bicarbonate or base excess differs from that expected, it is

TABLE 4.2 Summary of acid-base disturbances

Actual pH	$PaCO_2$	Base excess	Status
N	N	0	Normal
↑	↓	0	Acute respiratory alkalosis
↑	↓	Negative	Chronic respiratory alkalosis with metabolic compensation
N	↓	Negative	Respiratory alkalosis with complete compensation
↑	↑	Positive	Metabolic alkalosis with respiratory compensation
↓	↑	0	Acute respiratory acidosis without compensation
↓	↑	Positive	Chronic CO_2 retention with compensation
↓	↓	Negative	Metabolic acidosis with compensation
↓	N	Negative	Metabolic acidosis without respiratory compensation
↓	↑	Negative	Mixed respiratory and metabolic acidosis
↑	↓	Positive	Mixed respiratory and metabolic alkalosis

Note: N = normal.

TABLE 4.3 Acute and chronic changes with acid-base disorders

Primary process	Immediate effect	Acute compensation	Chronic compensation
Respiratory alkalosis	↑ pH 0.10 for every 10 mmHg fall in $PaCO_2$ below 40 mmHg	Bicarbonate ↓ 1 mmol/L for every 10 mmHg fall in $PaCO_2$ below 40 mmHg	Bicarbonate ↓ 2.5 mmol/L for every 10 mmHg fall in $PaCO_2$ below 40 mmHg
Respiratory acidosis	↓ pH 0.10 for every 10 mmHg rise in $PaCO_2$ above 40 mmHg	Bicarbonate ↑ 1 mmol/L for every 10 mmHg increase in $PaCO_2$ above 40 mmHg	Bicarbonate ↑ 4 mmol/L for every 10 mmHg increase in $PaCO_2$ above 40 mmHg

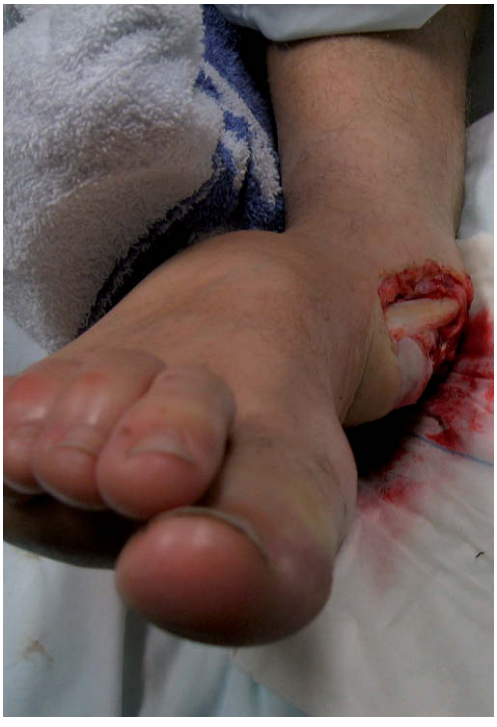
likely that a third disorder is also present. The most common 'triple disorders' are when patients with chronic respiratory acidosis develop an acute metabolic acidosis from infection or develop an acute respiratory acidosis from exhaustion or, less commonly, loss of hypoxic drive.

You are strongly encouraged to learn the causes of each of the primary acid-base disorders and to spend time analysing blood gas samples including calculating derived values. With practice, the calculations become almost automatic and the presence of triple disorders much easier to analyse.

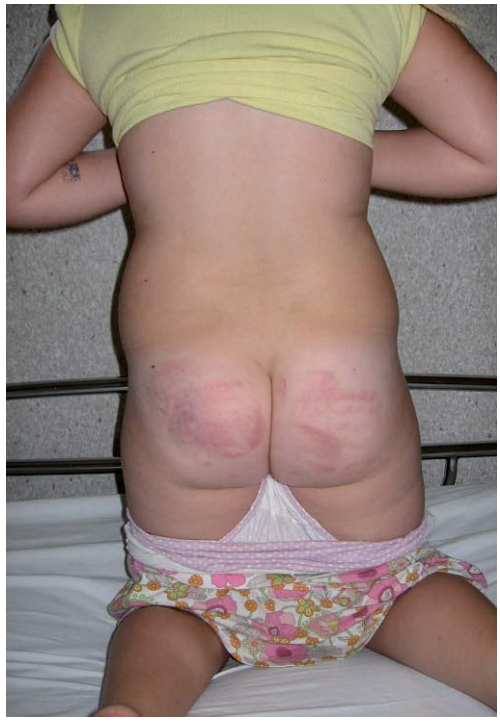
If you overcome your apprehension of the Siggaard-Andersen nomogram and take some time analysing its features, you will see how base excess is derived and even how the less prominent buffering effect of haemoglobin is included (Bohr and Haldane effects).

Key points

- Practise VAQs with every 'image' you encounter at work.
- Refine your style to write a seven and a half minute answer.
- Become familiar with common topics.
- Carefully read and answer the question asked.



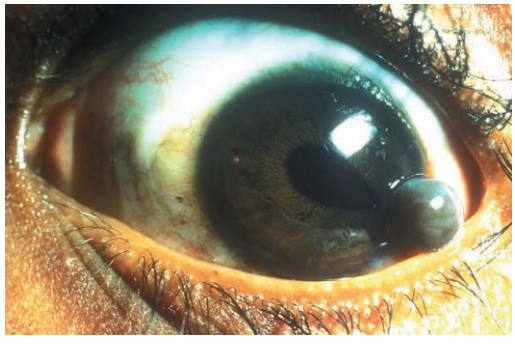
VAQ 1



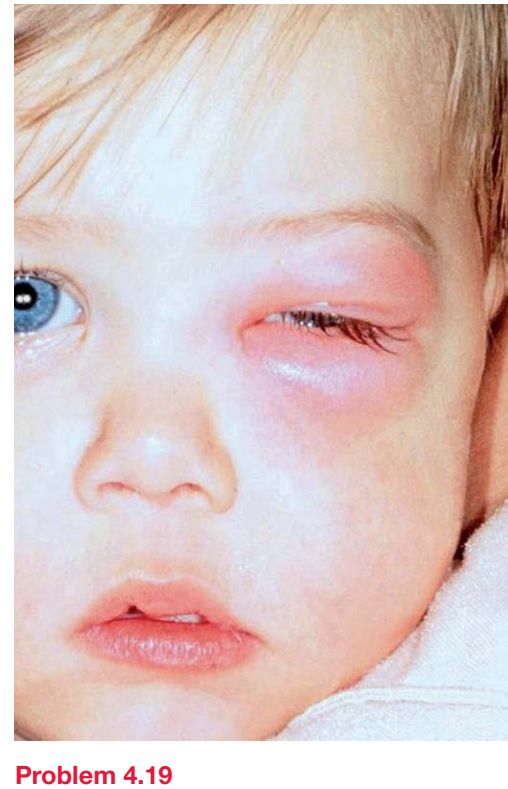
VAQ 4

Problem 4.16

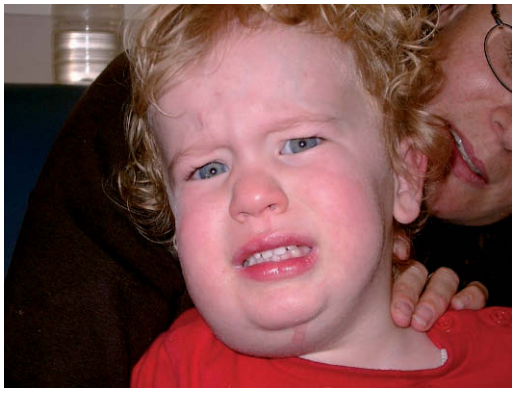
Problem 4.17



Problem 4.18



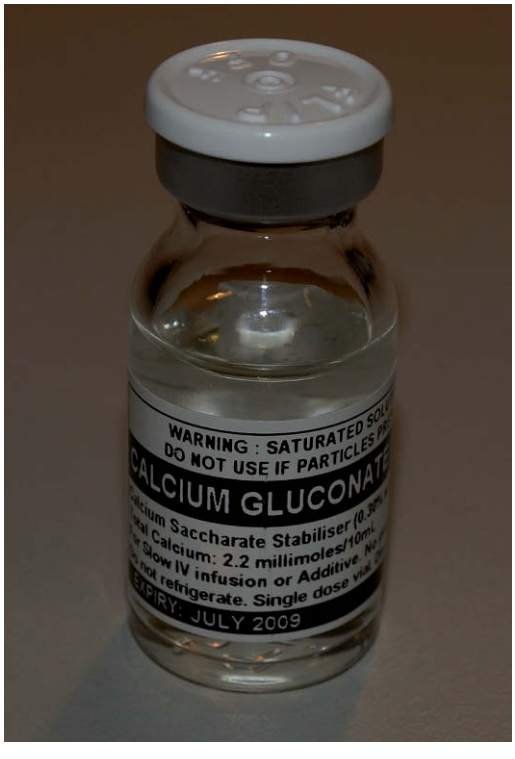
Problem 4.19



Problem 4.20

Problem 4.28

Problem 4.29



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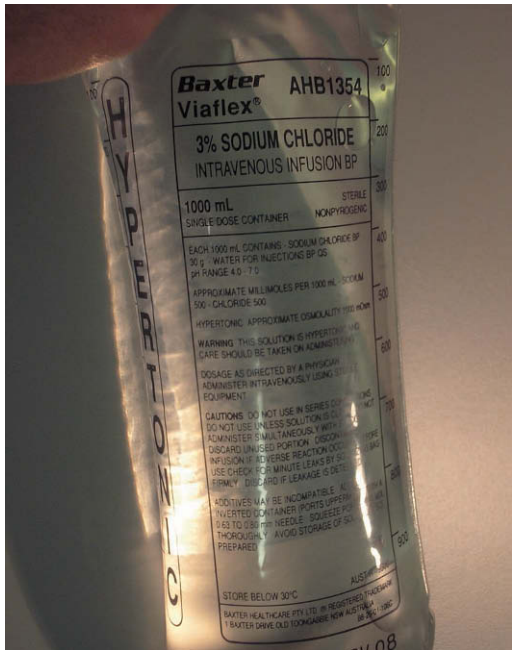

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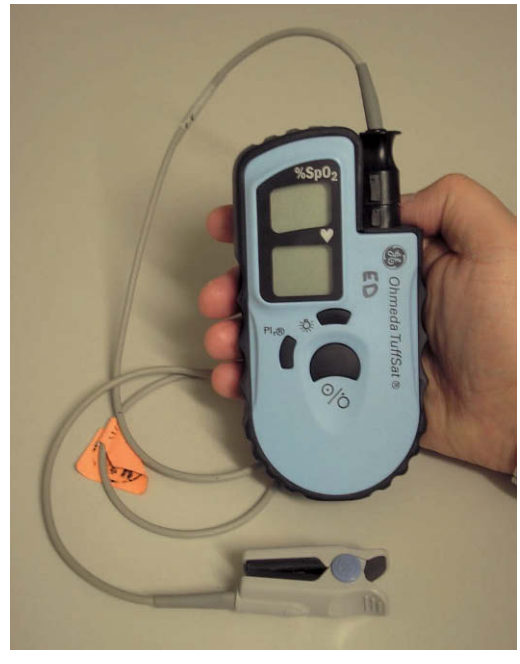
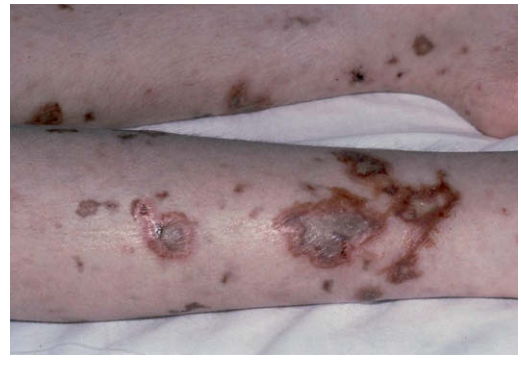


Problem 4.38

Problem 4.40



Problem 4.41

Chapter 5

The long case

> We are what we repeatedly do. Excellence, then,
> is not an act, but a habit.
>
> *Aristotle*

Traditionally, the long case section of the exam has a relatively good pass rate and many candidates view it as the easiest component of the examination to prepare for. Despite this, obtaining a good result requires specific preparation and planning.

Purpose

The long case is the examiners' opportunity to see how candidates 'put it all together' and therefore is your opportunity to showcase what you do on a daily basis. Four principles mentioned earlier in the book are tested in detail:

1. **How you perform during a usual day at work.** Taking a full history and examination, and deciding on initial investigations and management are absolutely core business for the specialty. Any clinical area may be presented, including paediatric and obstetric cases.
2. **How you identify and manage what is *common* and *commonly deadly*.** The majority of long cases are sourced by local venue organisers who 'spot' the cases in their own ED in the lead-up to the exam. This may include 'hot' cases just admitted to hospital. Cases that appeal to examiners are those with a story to tell, clinical signs to find and a total 'package' relevant to the practice of emergency medicine. Only a small percentage of patients come from outpatient areas without having been through ED. Questions that will be asked relate only to actual or possible ED presentations and focus on common and potentially lethal issues.
3. **How you attend to the 3Cs.** Concentrate on *condition* (diagnosis), *cause* (cause of the principal condition and/or precipitating factors for acute presentations) and *complications* (actual and potential).
4. **How you demonstrate practice at the level expected from a FACEM.** Judging how you engage with the examiners in a scenario where you are expected to perform as a competent junior colleague is a great way to find out whether you fit the bill.

Format

There is only one long case. You may take in your examination kit but not any written material. Notes are to be written on paper provided. You have 35 minutes with the patient to spend however you choose, followed by five minutes sitting outside the exam room to organise/consolidate/prepare your thoughts and written notes, followed by 20 minutes with two examiners for your presentation and questioning. During your

time with the examiners, one examiner will direct the questions while the other mostly observes and takes notes. The second examiner may occasionally ask questions to clarify issues, but typically remains silent. This pattern will continue for all the clinical components of the examination and is designed to ensure fairness and consistency. While one examiner is leading the discussion, the other is checking that you have addressed the relevant material. Both examiners agree on the final mark using these notes. Should you be unsuccessful in the examination overall, these notes will be used to provide you with feedback.

The examiners see the patient immediately before the exam *without* having access to the clinical notes. They decide what history can be elicited and what clinical signs are present (including relevant negatives) and determine how complex the case is. Both examiners see the patient to confirm the findings. After examining the patient, the examiners decide the direction of questioning of the candidates. The clinical notes are used, as they are in normal practice, to confirm the history as well as provide results of investigations. You will be expected to discuss any results as they relate to the case.

The presentation

The examiners usually allow candidates approximately 12–13 minutes for the presentation, during which time they will interrupt only to clarify an issue, not to ask questions regarding management. You are expected to provide all the details of a comprehensive patient evaluation — including the presenting complaint, past history, social history, medications, allergies, systems review and results of physical examination — and it is recommended that you end with a brief summary.

Start your presentation by providing a brief but informative introductory synopsis. You can modify the detailed summary of diagnostic or management problems from the notes you have already made and present it briefly as the synopsis, so this section does not need to be prepared separately. Your synopsis may focus on outlining *diagnostic* uncertainty and/or *management* problems, depending on which issues are more pressing from your perspective as a FACEM or from the patient's or family's viewpoint. The 'tree trunk' synopsis is the solid structure from which the rest of your long case presentation or 'branches' hang from and depend on.

The introductory synopsis naturally leads into a systematic presentation of the details of the case. For each section of the presentation, it is important to first mention the relevant positives or negatives that provide evidence for or support your synopsis and to use succinct language. For example, a systems review of a patient with a recent stroke could encapsulate a brief statement such as:

> On systems review, the patient has no clinical or historical features suggesting aspiration pneumonitis or pressure areas, but does have bowel disturbances associated with persistent immobility. There were no other symptoms relevant to the cardiovascular, renal, haematological . . .

This impresses on the examiners that you have approached the long case in a focused, relevant manner, rather than casting a wide net by asking questions from a comprehensive template attempting to cover everything.

Finalise your presentation with an end-of-case summary that elaborates on, rather than is identical to, your introductory synopsis. Whereas the opening synopsis introduces the diagnostic and management issues, the summary reinforces these and leads on to further investigation and treatment in priority order.

At the end of your presentation, the examiners may clarify some points or, unless you beat them to it, they will typically begin with the actual or potential ED presentations that could be expected with this patient. You may be shown results of investigations or other material from the patient's clinical notes as part of the discussion. All questions will relate specifically to this patient and thus will vary from you being asked about

a provisional diagnosis, a differential diagnosis and/or an investigation plan, right through to detailed management.

Assessment criteria

The examiners will have decided on the key criteria prior to the commencement of the examination and the complexity and difficulty of the case will be taken in to consideration. You will by assessed on the completeness, organisation, quality and timeliness of your history, examination findings, diagnostic assessment, plan of investigation and management of issues, as well as how you respond to questions and your overall ability to communicate at the level of a specialist.

Preparation

General preparation for this section of the exam is relatively easy as it covers very much what you do every day. Therefore, the best preparation is to remember the core principles (see Chapter 1) and use them constantly: all are relevant for the long case.

Most cases will have chronic, often multi-system diseases with a number of historical and examination findings. Time spent as a medical registrar and in specialty clinics will serve you well.

The principal difference between the long case and your everyday work is the long case's time constraint. Therefore, you need to practise and become comfortable working within this time frame. The more practice cases you do, the easier it becomes to develop a 'feel' for how best to spend the 35 minutes for both the history and examination, how to structure your presentation and anticipate likely lead questions during the five-minute interlude, and how to deliver your presentation in about 12 minutes. We recommend that you practise a minimum of 10 cases under examination conditions with a suitably experienced 'examiner'.

Table 5.1 outlines important cases to review, although this is by no means an exhaustive list of what you can expect to encounter in the exam. Look out for patients with these conditions at work during your exam preparations. It is always beneficial

TABLE 5.1 Long cases you should be familiar with

Cardiomyopathy
Chronic liver disease (e.g. alcoholic, Wilson's disease, haemochromatosis)
Chronic neurological conditions
- motor neurone disease
- multiple sclerosis
- muscular dystrophy

Chronic renal disease — especially on peritoneal dialysis or haemodialysis
Chronic respiratory disease (e.g. COPD, fibrosing lung disease)
Connective tissue disease
Diabetes mellitus with complications
Haematological conditions
- chronic anaemia (e.g. sickle cell disease, thalassaemia)
- myelodysplasia
- myeloproliferative disorder (e.g. polycythaemia vera)

Immunodeficiency with complications
Inflammatory bowel disease
Ischaemic heart disease
Malignancy — especially with complications (e.g. metastases, organomegaly)
Neurofibromatosis
Rheumatoid arthritis
Stroke with residual weakness or functional impairment (e.g. neglect)
Transplant recipients — heart, lung, kidney
The patient with multiple co-morbid problems

TABLE 5.2 Examples of the 3Cs as they apply to some common long cases

Condition	Cause	Complications	High-probability questions
Chronic renal failure	• Primary cause of renal failure — chronic hypertension, diabetes, polycystic kidney disease, glomerulonephritis, obstructive or reflux nephropathy, autoimmune disorders • Presentations can relate to renal failure crises (e.g. acute pulmonary oedema), dialysis-related problems (e.g. CAPD-related peritonitis), intercurrent infections, complications of primary disorders (e.g. bleeding into a cyst with flank pain and haematuria)	• Cardiac arrest — hyperkalaemia • Acute pulmonary oedema • Vascular access problems (e.g. fistula bleeding, occlusion, infection, aneurysms) • Uraemia (e.g. pericardial effusion, encephalopathy) • Severe acidosis • Hypocalcaemia • Hyponatraemia and seizures • Peritoneal dialysis problems (e.g. local catheter infection, peritonitis, constipation) • Hypermagnesaemia • Hyperphosphataemia • Anaemia • Peripheral neuropathy • Dialysis dysequilibrium syndrome • Recent or failed renal transplant — possible immunosuppression side effects • Underlying disease complications	• What electrolyte abnormalities may be present and what symptoms may be associated? • What are the indications for urgent dialysis? • What are the clinical features and differential diagnosis of CAPD-associated peritonitis? • How would you diagnose and treat severe hyperkalaemia? • What are the possible side effects of cyclosporine? Steroids? • What are the common causes of chronic renal failure?

to have seen actual patients who can literally be 'walking textbooks'. Recalling your management of actual cases is easier than trying to remember lists from texts.

Examination Medicine (by NJ Talley and S O'Connor; Churchill Livingstone, Sydney) is an excellent resource to assist preparation for medical cases, although it must be appreciated that there is by necessity a different focus for the FACEM exam, with the emphasis on departmental management rather than long-term care.

Considering how the 3Cs apply to each potential long case problem will enable you to pre-empt and prepare for the obvious relevant questions you could be asked in the exam. Some examples of this approach are provided in Table 5.2.

On the day

Time with the patient (35 minutes)

You may be provided with the patient's medication chart (if an in-patient) or the patient may have a list. If not, compile a list as best you can — as you would during a clinical shift in ED. Some observations may be provided where pertinent, but none should be expected or demanded. If you want a blood pressure and it is not provided,

TABLE 5.2 Examples of the 3Cs as they apply to some common long cases (Continued)

Condition	Cause	Complications	High-probability questions
Chronic obstructive pulmonary disease (COPD)	• Smoking and alpha1antitrypsin deficiency • Acute exacerbations may be due to infection, medication non-compliance, sedatives, fluid overload etc.	• Recurrent infections • Symptomatic hypercapnoea • Dysrhythmias (e.g. AF, PAT) • Pneumothoraces • Cor pulmonale • Polycythaemia • Impaired exercise capacity • Malnutrition • Depression • Recurrent hospitalisations • Inability to cope at home	• What are the possible reasons for acute exacerbations of COPD? • What is the role of non-invasive ventilation? • How will you determine whether this patient should be intubated? • What is your approach to oxygen therapy?
Ischaemic heart disease (IHD)	• Cardiac risk factors: chronic hypertension, diabetes, hypercholesterolaemia, smoking, obesity, family history • Can present with an acute coronary syndrome, heart failure or rhythm disorder associated with ischaemic cardiomyopathy, treatment side effects (e.g. diuretics, ACE inhibitors, anticoagulants, cardiac catheterisation)	• STEMI • Non-STEMI • Cardiac arrest • Heart failure — acute or chronic • Dysrhythmias — tachy- or bradycardias • Implantable cardioverter defibrillator (ICD) and pacemaker problems • Bleeding from anticoagulants • Femoral artery aneurysm from angiography • Electrolyte abnormalities from drugs • Renal failure	• What are the relative merits of thrombolysis versus angioplasty for acute STEMI? • What are the criteria and contraindications for thrombolysis? • How would you manage an out-of-hospital cardiac arrest due to VF in a patient with suspected IHD? • What are the issues relevant to managing a GI bleed in a patient who has had a very recent drug-eluting coronary stent inserted?

measure it. If fundal examination is relevant to the case (e.g. diabetic, stroke, visual field defect), you will be provided with an ophthalmoscope. However, potentially embarrassing examinations such as PR or PV examinations are not to be undertaken. You will have time with the examiners to say what other aspects would make part of your normal examination. Where relevant, these findings will be provided by the examiners.

For outpatients, start with their previous presentations, remembering one of these may be the starting point of discussions with the examiners.

History taking and examination

Introduce yourself to the patient and thank them for taking part. Apologise that you are rushed for time and so may be more abrupt than you usually would.

After you have established rapport, take a history using a focused approach, with headings that you have practised and are familiar with. This process is not mechanical; it requires interacting with, and hearing, the patient. Informative questioning requires you to synthesise information as it becomes available, and to adjust the choice and emphases of subsequent questions accordingly. Although you are dutifully following predefined headings, you need to ask questions that relate to the important issues for *this* patient, as they will be the likely focus the examiners will take. A good patient historian will provide you with a logical, sequential and relevant narrative, but some patients will require repeated but courteous redirection.

You need to have alternative strategies if the patient is a teenager or has a cognitive or communication disorder. Remember that teenage patients in long cases often have chronic diseases such as cystic fibrosis and frequently have illness behaviour that has resulted from chronic hospitalisations. Your communication strategy needs to be sensitive to these limitations and adjusted accordingly. The examiners will be aware of these difficulties and will have taken them into account. Where communication is difficult, it is likely there will be a greater focus on clinical findings and/or a collateral history will be required.

Continue the history while examining the patient. Where necessary, the history can be supplemented as you discover more physical signs. Commence examination as soon as is practicable; ensure that the patient is adequately undressed but not immodestly or uncomfortably so. Remember, other candidates may have already seen this patient, which is advantageous if they are better versed at what they are expected to tell or show you, but a disadvantage if they are tired, bored and irritable. Be attuned to the patient's mood state; do not hurry the examination if this is likely to be perceived to be uncaring.

Even if there is no apparent indication, the physical examination should address every system, at least briefly. An unexpected cardiac murmur or large scar on the back the patient has forgotten to mention will be more than embarrassing when you are asked about it later.

It is worthwhile spending a minute at the start of your allocated time setting out your paper in the way you have practised, as this will help prevent omissions. An example of some section headings to consider is provided in Table 5.3. Modification is needed for different types of patients (e.g. a birth, developmental and immunisation history will be most relevant for children).

Organise your notes so that each section is on a different piece of paper (or is clearly delineated if multiple pieces of paper will be difficult for you to manage). This will enable you to add, change and rearrange the sections depending on how you wish to present the case later. It will also act as a handy reference should you be asked a question regarding something you know you asked but cannot recall the detail.

The long case, more than any other component of the fellowship examination, is an opportunity to demonstrate your ability to address the 3Cs. The diagnosis (*condition*) will be a focal point of your initial discussion with the examiners. Initial management, investigations and subsequent in-hospital course are all related to actual or potential *complications*. The discussion on management of the patient will have to address precipitating factors (*causes*) before discharge or the patient will re-present. Specifically considering the 3Cs during your time with the patient will help guide you, and may prompt you to gain more history and/or examine for a particular feature that may otherwise have escaped your attention.

Aim to finish your history and examination with time to spare before your 35 minutes are up. Make sure you ask the patient whether there was anything the examiners

TABLE 5.3 Possible subheadings for the long case presentation

Presenting complaint
History of presenting complaint
Past history
- medical
- surgical
- obstetric
- psychiatric
- birth
- developmental

Systems review*
- cardiovascular
- respiratory
- gastrointestinal
- hepatic
- renal
- urological
- neurological
- musculoskeletal
- dermatological
- haematological
- endocrine
- reproductive

Personal history
- family history
- social situation
- smoking
- alcohol and illicit drug use

Medications
- prescribed
- natural therapies
- over-the-counter agents

Allergies
Immunisations
Physical examination
- vital signs
- general appearance
- cardiovascular
- respiratory
- gastrointestinal
- hepatic
- renal
- haematologic
- neurological
- musculoskeletal
- dermatological

Diagnostic list
Management strategies
Summary of key points for the presentation

* Developing a mnemonic for the various systems is a good way to ensure all systems are covered.

seemed particularly interested in or any aspect of the history or examination they elicited that you have not. Having spare time will enable you to explore more detail if needed, confirm any findings you were unsure about and commence the process of collating your thoughts. If you start this while you are still with the patient, you have the opportunity to complete any 'gaps' that may suddenly come to mind.

The five-minute break

The five minutes will pass very quickly, so be prepared for what you need to do during this time. By now you should have identified the key features of the history and examination, so use the time to consider your introductory synopsis and your closing summary and how you will proceed after the presentation. If you are happy with the clinical scenario, write down the key points so that you can present them in your introductory synopsis. Similarly, for your closing summary, consider the issues and make a bullet point list to refer to, putting the issues in priority order and noting whether they are active or inactive.

Arrange your sheets of paper in the order you wish to present them or clearly number the sections if you have not used one piece of paper for each item. Check again to ensure completeness and whether there are potential areas of discussion that you have not considered.

At the end of the presentation, the examiners will ask you some questions. Initial questions will relate to ED presentations (actual or potential for this patient). Use this time to consider what those questions are likely to be, organise your thoughts and prepare your responses. You should also decide whether you wish to lead or be led in this 'dance' with the examiners.

The presentation and discussion

When you enter the exam room, assume that you are about to have a discussion with colleagues. Enter as a consultant would. Be confident but not overly so, sit comfortably and use appropriate body language. If you are prone to nervous hand movements, develop a way of controlling this — such as always keeping your hands on either side of your notes. Remember to address the active examiner *and* the co-examiner by maintaining eye contact with both.

If you are comfortable with the overall scenario, let the examiners know this from the outset. For example:

> I saw Mr Jones, a 45-year-old man, currently in hospital having fallen two weeks ago while intoxicated and suffering a neck of femur fracture. He is an alcoholic and describes features of withdrawal last week, and his social circumstances of living alone in a hotel need to be addressed before safe discharge can be effected. His history in more detail . . .

If the scenario is not straightforward, an initial brief synopsis is still possible. There are plenty of patients on wards and at home who do not have firm diagnoses. However, they all have conditions that can be addressed as a management plan or working diagnosis. Presenting this reassures the examiners that you are able to rationally synthesise and appropriately manage uncertainty.

Present as a FACEM, not as a medical student, and give only positive findings and relevant negatives. Long lists of irrelevant negatives put the examiners to sleep, serve to confirm that you are not able to present as a FACEM and, most importantly, consume time you could be using to demonstrate your diagnostic and management abilities.

Do *not* apologise or complain if the history and/or examination were difficult. The examiners saw the patient before you and will take this into account when deciding on your mark. A more productive approach is to present the 'difficulty' with constructive suggestions to manage it. Compare these presentations of the same issue:

> [Apologetic] I'm sorry, I couldn't get a proper history from Mr Jones because he kept changing his story and couldn't remember details. I don't trust it and I'm not sure what is real or not. He said he lived alone but then said he lived with friends . . .

> [Productive] Mr Jones' history was incomplete and inconsistent. Given his features of alcoholic liver disease this is most likely confabulation. I would confirm all of the history with reliable sources. With this in mind, the history obtained was . . .

You have approximately 12–13 minutes for your presentation and will be interrupted only to clarify a point or if you are running out of time for the examiners to ask questions.

When the questions do commence, expect the first one to be 'Describe your approach to the patient if they presented to your ED as they did on [this or a particular past] presentation'. In the less common scenario where the patient has had no acute ED presentations, this first question will most likely be in relation to a common acute presentation with this clinical condition. Because you know what the question is likely to be, you may choose to lead into it — as a 'real' FACEM would.

> If Mr Jones presented to my ED with a painful hip following a fall, I would rapidly assess him for other injuries or threats to life and manage them accordingly. If there were none, my first priority would be analgesia followed by confirmation of diagnosis and evaluation for co-morbid conditions. Specifically, my approach would be . . .

If the examiners wish to discuss a different presentation or potential presentation, they will redirect you. If so, you have lost nothing by demonstrating initiative.

The remainder of the discussion will be relevant to the case. Therefore, a similar strategy can be adopted and after addressing the first question, you may choose to continue with 'interesting' aspects, as a FACEM would discuss them. If you lead, the examiners may choose to let you continue a pertinent discussion rather than having to lead you. Think of what is *common* and what is *commonly deadly* for this patient. Any of these should be considered likely discussion points, as well as uncommon features that imply a complication or an alternative diagnosis.

A suggested 'style' is to raise an issue, remark why it is relevant, discuss possible explanations and suggest how you would address it. This can then lead to other relevant issues, which can also be presented in the same manner. For example:

> It is unusual for a man of this age to sustain a neck of femur fracture. Presumably this is related to malnutrition, but I would examine the initial films carefully to ensure this was not a pathological fracture. Mr Jones' in-patient course was complicated by withdrawal symptoms that were managed in the usual way.
>
> Of interest, however, is that he has only a sketchy recall of the last week other than receiving blood transfusions and what sounds like an upper GI endoscopy. This is not common for a simple #NOF. My suspicion is that he may have had an upper GI bleed related to his alcohol abuse. For him, the most likely cause would be peptic ulcer. There were no stigmata of portal hypertension, so a variceal bleed would be less likely although should still be considered. With a GI bleed, encephalopathy could result, which may have impaired his memory even more so for that period and potentially could even be why his history is inconsistent now.
>
> He has no asterixis now so, if encephalopathy was present, it is no longer an active consideration. I would like to clarify that he has received thiamine . . .

The examiners may choose to stop you if they intend to discuss any of the features you raise. Alternatively, they may let you keep going, so long as you are describing relevant features, discussing the pros and cons of possible diagnoses and management options, and keeping to the case at hand. If they do not stop you and you have presented all the 'interesting' aspects you have on your list, start going into more detail for one of them.

> Upper GI bleeds present a particularly interesting management issue in alcoholics. From the emergency medicine perspective, the principal conditions to consider are . . .

Should you be redirected by the examiners, listen carefully to the question and answer it. Do not be concerned: redirection means either the examiners have decided the current line of questioning has demonstrated your abilities, their focus is in a different direction or they want to explore more 'breadth' instead of just 'depth'. Maintain the same confident approach you brought into the room for a discussion with fellow colleagues until the bell goes.

Key points

- Practise your long case technique with every patient you see at work.
- Take opportunities to practise with an 'examiner' under exam conditions.
- Practise a format for presenting your case which pre-empts examiners' questions.
- Consider potential emergency presentations relevant to your case while preparing your presentation.

Chapter 6

The short cases

> Clinical examination is more art than science.
> When the art is practised well, the science
> (investigation) is merely confirmatory.
>
> *The authors' mantra*

The short cases require practice over a period of time.

Purpose

The individual short cases are the examiners' opportunity to see how candidates elicit physical signs and therefore give candidates the opportunity to showcase what they do on a daily basis.

Format

Each candidate sees four short cases, two cases with one pair of examiners and two cases with a different pair of examiners. Each of the four examiners will act as the lead for an individual case. For each pair of cases you have 20 minutes, although the time allocated to each case may not be equal, depending on the complexity of cases. As with the long case, bells are used to signal the start and finish of each section. When the bell sounds for the end of the first 20-minute session, you will be redirected to sit outside another room ready for the second session. Following a five-minute break, you will be taken by the second pair of examiners to your other two cases for a further 20 minutes.

The 'typical' split of the short cases is one cardiovascular, one neurological, one of either respiratory or abdominal and one other. However, the actual cases used will depend on availability on the day. Therefore, more than one case may be given from the same system. None of the above categories are mandatory and the order of cases varies. At least one short case will be paediatric.

As a guide, for each case approximately seven minutes is usually assigned to the clinical examination before presentation and questions. You will be given the choice of presenting your findings as you go or at the end. Any further discussion will relate only to the case at hand. The focus will be on synthesising findings for a diagnosis or differential diagnosis, including further methods to clarify this. On occasion you may be shown results of relevant investigations that assist in the differential diagnosis, although time constraints will usually prevent this.

Preparation

The majority of short cases will be outpatients with painless, stable, well-documented signs. Most of these patients are well trained and follow instructions easily. Really well trained patients will even anticipate your next move and position themselves accordingly. However, a good 'hot' case from the emergency department will not be overlooked. For this reason, your examination technique also has to work for the 'untrained' patient — and, as such, it has to work in your everyday work life. Remember, the most efficient way to examine a system is via the short case technique. You should therefore consider practising this technique as preparing for all your future patient examinations, not simply rehearsing for the fellowship exam.

There is no substitute for practice. Each component of the short case is important and requires preparation and practice. This means becoming familiar with:

- the equipment you will use
- the setting in which you see patients
- the range of patients you will see
- the technique and timing of the clinical examination
- presenting each case
- answering questions on each case.

The only way to look slick and present with ease is to have done it a sufficient number of times so you do not have to think about it.

Become familiar with your chosen location for your equipment, especially pins, cotton wool, tuning fork and tendon hammer for the neurological examination. Most candidates prefer to use their own ophthalmoscope and auroscope. By necessity, those provided are often slightly different from the kind normally in use at your workplace. Practising on 'normal' volunteers is an excellent way to become familiar with your examination 'kit' without having to suffer the embarrassment of disorientation in front of real patients.

Be comfortable doing basic observations. A FACEM should look slick measuring blood pressure, pulse rate, respiratory rate, SaO_2 and temperature. Practising these skills will help enormously. Recording them in the notes at work and encouraging others to do likewise will also engender good working relationships with the nursing staff.

When given a patient's name, use it a few times straight away (as this is also your only time to ask again or be corrected successfully if you get it wrong) and regularly afterwards. This technique is a favourite for salespeople. Calling people by name engages them earlier, makes them relaxed and engenders a sense that you are taking a personal interest in them. Try it, and compare the results with when you don't do this.

You will be given the choice of presenting your findings as you go or at the end. Most major systems (e.g. cardiovascular) are better suited to a summation at the end as you accumulate diagnostic information along the way. For others where the diagnosis is apparent but several signs need to be demonstrated (e.g. rheumatoid hands or examination of a lump), presenting as you go ensures you do not omit findings.

Top athletes are taught: 'Train as you intend to compete, because you will always compete as you train.' Become familiar with examining each system in a maximum of seven minutes. If your 'normal' approach varies with each patient and changes in duration, your performance at the examination (competition for marks) will reflect this. Practise individual examinations with someone timing you. This can be done at home with friends or family members who are happy to volunteer: they will soon be able to tell you when you have missed something. A word of warning: if your partner or family members become the 'subjects' for your practice, remember that time spent together in this way does *not* count as 'quality time'.

Teaming up with physician trainees is a great way to discover medical short cases, and they will also make useful allies as practice examiners and examinees. A number of textbooks include likely medical short cases. However, the specialty of emergency medicine covers much more than general medical cases: you must also search out short cases from other specialty areas in wards, clinics and rooms. Seeing patients in surroundings that are unfamiliar to you is good practice for the exam itself.

The following are some of the more likely conditions with which you should seek experience in addition to those that physician trainees will be seeking, although this list is far from exhaustive:

- **Paediatrics:** almost any adult condition can be present in children as well. Your interaction with the child and parent will be on display. Children also present with a variety of syndromes, not all of which will have names you are familiar with. Identifying abnormalities is more important than knowing the name. Ensure that you know the normal childhood milestones and how to do a 'baby check'.
- **Surgery:** hernias, organomegaly, ulcers, vascular insufficiency, varicose veins, and breast and thyroid examination.
- **Orthopaedics:** joints, especially the knees.
- **Obstetrics:** normal pregnancy assessment and features of pre-eclampsia.
- **Trauma unit:** peripheral nerve injuries including the brachial plexus, and facial injuries with complications (e.g. cranial nerve injury, orbital blow-out fractures).

Practise presenting your cases as succinctly as possible. Remember that some descriptors are pathognomonic and should be used only if you are confident of the diagnosis. For example, a 'collapsing pulse' and a 'plateau pulse' are specific for aortic incompetence and aortic stenosis, respectively. Describing the pulse as 'full volume' or 'low volume' is safer if you are unsure. Practising as both examiner and examinee will allow you to iron out quirks and habits that can be annoying. Using 'um' excessively needs to be brought to your attention early, so you can amend your language accordingly. Avoid using terms such as 'middle-aged' and 'gentleman', which can become points of debate in themselves: 'man', 'woman', 'child' and 'baby' are safer terms. If you can practise some sessions with an examiner, they can help with this task. Your DEMT and other FACEMs will also be helpful, as will other trainees preparing for the fellowship exam. Be constructive in your critique of others and encourage them to be likewise. The intention of this practice is to allow you to develop a 'style' where you present as a competent colleague. You do not want to be giving a lecture (over-confident) or to look stunned before each question expecting a hidden agenda (under-confident). Constructive critique from and of others will help you to find your way.

Whenever you need to get some fresh air, spend it casually watching people walk in and out of the outpatient clinic and/or main entrance of the hospital (or while shopping or going for a walk). This is especially good practice for analysing gait patterns, and you can challenge colleagues on how many people you can diagnose from a distance. You will be surprised how often this can be done!

Anticipate the questions that will be asked and practise your answers. The expected series of questions the examiners will ask are:

- What else would you like to examine?
- Present your findings so far.
- Can you put these findings together?
- What else could it be?
- What supports one differential over another?
- What else could you do to clarify things further?
- Are there any features suggesting a specific aetiology?

Examining a candidate who provides the answers in a logical fashion without being asked is more satisfying than having to drag the answers out of a candidate one at a

time. The more competent you are, the higher you will score. Later sections in this chapter include examples of responses that enable you to keep talking until you are stopped.

Some systems are well suited to prepared answers. Cardiovascular examination, for example, has a relatively limited number of diagnoses, and the more common ones should be rehearsed. Well-prepared candidates will anticipate these diagnoses and present their findings in a thorough polished manner before being asked. Being well prepared saves time and enables you to maximise the information you are giving. If, for some reason, you are off track, the examiners will stop and redirect you.

The final part of your preparation is the 'dress rehearsal'. Ensure that you practise a couple of each of the major system examinations in your examination outfit. This will confirm that it is comfortable and practical and make you more at ease on the day.

On the day

In the current structure, the short cases are undertaken on the afternoon of the first day, after the long case. There is a lunchbreak for the examiners between the long and short cases, so your break will be at least this long. Typically, you will have a few hours between your sessions. Use the time to relax and eat something that is easy to digest and will not make you sleepy.

At the end of the break, expect to get right down to business. The examiners will be ready, directing you straight to your first case.

Hand-cleaning facilities will be available in each patient area, similar to everyday practice. Good FACEMs wash their hands between patients. Act like a FACEM.

Listen carefully to the introduction, including the patient's name and what you are being asked to examine. Use the patient's name as soon as possible, as you have practised. If you do not understand an instruction, ask for clarification.

The issue of whether to present the examination findings as you go or to complete the examination before summarising what you have found is a matter of personal choice. The examiners will allow you to present either way. Regardless of which method you choose, be mindful of the time. The examiners will want to ask questions, so your examination and presentation need to be timed to allow for this. If you elect to present at the end and your examination is slow, the examiners will stop you when they need to ask questions. If you present as you go but spend time presenting irrelevant material, you may run out of time.

After each case, try to clear your mind and be ready to start afresh for the next one. Each case is marked independently from the others so treat them as such. Although it is human nature to mull over past performance, it is not helpful. During the five-minute break between sessions, collect your thoughts, and ensure that your 'kit' is back together and everything is in its correct pocket. The second set of examiners will not know how you performed in the first two cases.

Depending on the number of candidates, after you have completed your four cases you may be quarantined until the last group has finished. Be prepared for this and use it as an opportunity to wind down, as you will be tired after a long day.

Examination approaches

> It is the theory that decides what we can observe.
>
> *Albert Einstein*

The following sections provide a suggested method for approaching commonly encountered cases, along with possible introductions that may be used by your

examiners. These descriptions are not exhaustive of the countless number of clinical signs that may be detectable, but they do provide an organised framework that will enable you to detect all abnormal findings.

For comprehensive background material, you will find it invaluable to refer to excellent resources such as:

- Talley N, O'Connor S. Clinical Examination: A Systematic Guide to Physical Diagnosis, 5th edn. Elsevier, Sydney, 2006.
- Ryder REJ, Mir MA, Freeman EA. An Aid to the MRCP Short Cases, 3rd edn. Blackwell, Oxford, 2003.
- Harris W, Timms B, Choong R. Examination Paediatrics: A Guide to Paediatric Training, 3rd edn. Elsevier, Sydney, 2006.
- Browse N et al. Browse's Introduction to the Symptoms and Signs of Surgical Disease, 4th edn. Hodder Arnold, London, 2005.

This chapter does not aim to be a substitute for these educational sources. Rather, it complements these books by reviewing areas of key importance, with particular emphasis on areas that FACEM exam candidates are commonly asked and/or classically struggle with (e.g. neurology).

Examples are also provided of the lay language that may be used when engaging with patients in the exam. This is *not* meant to be condescending to prospective candidates, but is included as an extension of the requests we sometimes receive from trainees to model how we would succinctly interact with and instruct patients under exam conditions. Ultimately, we recommend using the same approaches you would use in 'real life' and encourage you to develop your own efficient but friendly professional banter.

Cardiovascular system examination

The examiner's introduction is usually nondescript and directs you to examine the whole cardiovascular system:

> **'Mr Jones has a cardiac condition. Please examine his cardiovascular system.'**

Specific direction indicates key findings the examiners wish to focus on, maximising your time. Do not be concerned: this gives you more time for a detailed examination. If you are directed to the praecordium, examine the praecordium — do not examine the peripheries. However, you will be able to note the patient's general appearance and usually JVP while auscultating.

Getting started

Introduce yourself to the patient using the patient's name, while making a show that you are confirming the patient's posture at 45 degrees.

> Hello, Mr Jones. Can I just check you're sitting comfortably?

Once the patient is settled, step back sufficiently to be able to scan the whole area, including the bedside table, underneath the trolley and so on for any clues. Note them as you discover them:

> I don't see any evidence of medical therapy such as oxygen. I presume that this is Mr Jones' walking stick.

Observe the patient's general appearance, colour (anaemia, plethora, cyanosis), pursed-lip breathing, respiratory rate and obvious scars. The JVP may be visible at a distance. Head bobbing is an uncommon sign of aortic incompetence (AI), but easily missed if not specifically checked for.

Peripheries

Start from the hands checking for anaemia, cyanosis, pulsations in the nail beds (AI) and stigmata of endocarditis (e.g. splinter haemorrhages in the nail beds, digital septic emboli, haemorrhagic Janeway lesions in the palms).

Feel the pulse for rate, rhythm and volume. While checking the pulse, you have more opportunity to check the hands and scan the rest of the patient. If the pulse is particularly good volume, try feeling with your fingers flattened against the radial pulse with the patient's forearm elevated (tapping pulse of AI).

As you move up the arm, feel the brachial pulse and politely ask the examiners:

Is there a blood pressure available?

Listen carefully to the numbers and remember them. Occasionally you may be directed to measure the patient's blood pressure yourself. This is neither a good nor a bad thing. You may be asked to do so because the blood pressure is interesting (low pulse pressure in aortic stenosis (AS), high in AI) or because the case allows time for this and the examiners want to see whether you are competent in a basic procedure. Looking offended when directed to measure the blood pressure or fumbling around indicating that this is something you haven't done in a long time is not a good way to impress.

Move to the neck, feel the carotid pulse for character and auscultate for bruits:

I'm just going to listen to your neck.

If breathing is noisy, give clear instructions:

Breathe in . . . Breathe out . . . Stop . . . Now breathe normally.

Assess the JVP. If it is not visible, make sure it is not too low (try a hepatojugular response — *Mr Jones, is it okay if I just press on your belly briefly?*) or too high, in which case the distended vein will become measurable sitting up. Sinus rhythm gives a regular double pulsation. If the patient is in AF, look carefully for cannon waves on top of single pulsations. Large fluctuations (CV waves) are seen with tricuspid incompetence (TI).

Check briefly for conjunctival pallor and central cyanosis (lips and tongue).

Praecordium

Inspect for a visible apex beat or heaves and scan for scars (which may be in the axilla). Sternotomy scars without evidence of vein grafting should raise suspicion of surgery for valves or transplant. Internal mammary grafts are associated with multiple vascular clips on CXR. Do not miss a pacemaker or ICD insertion pocket scar.

Feel for the apex beat. If not palpable, reach out to the posterior axilla. If still not palpable, consider that it may be on the other side (dextrocardia). Once located, confirm its position relative to the mid-clavicular line (or anterior/mid-axillary lines if displaced significantly) and whether it is normal, forceful or otherwise.

After feeling for the apex beat, palpate vertically alongside the sternum for thrills or ventricular heaves (using the heel of your palm) and finally feel horizontally across the heart base.

Auscultation starts at the apex beat with the stethoscope diaphragm. Deliberately focus on the first heart sound, then the second (including splitting and change of splitting with respiration; identify mechanical valvular sounds). Specifically listen for a third, fourth and then additional heart sounds. Clicks may be loud and dismissed as extraneous sounds. Listen first for systolic and then diastolic murmurs.

After listening at the apex (mitral area), listen in turn to the lower left sternal edge (tricuspid area), then the left upper sternal edge (pulmonary area) and right upper

sternal edge (aortic area). Confirm the timing of any murmur by simultaneously palpating the carotid pulse and listen in the axilla and carotids for radiation. Right heart murmurs are louder with inspiration and the opposite is true for left-sided murmurs, so ask the patient to take some slow, deep breaths while listening for changes with the respiratory cycle.

After listening with the diaphragm to all four areas, change to the bell on the stethoscope. The tone difference of mitral stenosis requires a change in mental focus initially to 'tune in': listen with the bell held lightly against the chest over the apex. Do not press firmly as this may obliterate a soft mitral diastolic murmur. Lying on the left side accentuates mitral murmurs. Flatten the bed in anticipation of further examination: *Could I please ask you to lie down on your left side?* Palpate the apex beat again (it usually moves) and identify mitral murmurs.

Sit the patient up: *Can I get you to sit up and lean forward?* Feel the parasternal area again for thrills or heaves. An AI murmur is best heard with the diaphragm as the patient leans forward at end expiration: *Please take a big breath in . . . Breathe right out . . . Stop . . . Now breathe normally.*

If you have heard a clear aortic outflow murmur, you may wish to try isometric exercise at this stage: *Make a loose fist with your hands. Squeeze hard when I say so.* Listen for the character of the murmur: *Squeeze now* [listen] . . . *and relax* [listen again]. Murmurs associated with HOCM will decrease with isometric exercise, while those associated with aortic valve obstruction will increase. Valsalva has the opposite effect. If you are seriously considering HOCM at this stage (it is more common in exams than in real life), it may be worthwhile going ahead with other manoeuvres such as squatting in a mobile patient (HOCM decreases with squatting down and increases on rising from the squat; aortic valve obstruction is the reverse). Although it is uncommon to demonstrate these manoeuvres, if you do suggest them during discussion, you must be prepared to demonstrate them.

When the patient is sitting up, check for sacral oedema and basal crackles. Thoracotomy and valvotomy scars are also best seen from behind.

With the patient supine, check for hepatic enlargement and pulsatility. Checking the legs for oedema, deep vein thrombosis and scars from bypass grafting completes the examination.

With practice, you can complete all the above within seven minutes. If not, you will be stopped before you complete your examination.

As you progress through your cardiovascular system examination you will receive 'clues'. For example:

- The presence of AF makes mitral valve disease more likely, while absence makes it less likely. Low-volume pulses are associated with obstructive lesions, while high-volume pulses are associated with valvular incompetence.
- A high JVP and exaggeration of a pansystolic murmur with inspiration suggest a right-sided lesion. Tricuspid incompetence is likely and therefore a pulsatile liver is to be expected.

If you detect all the peripheral clues, you should have a reasonable indication of the likely diagnosis before you even auscultate. If so, you should be thinking of other features that support or refute your diagnosis or give indications of severity.

Discussion

The examiners will stop you with a clear statement, followed by: 'What else would you like to examine?' Respond with:

> I would complete my cardiovascular system examination with [whatever you have not done] as well as completing a general examination including [whichever observations have not been done] and a urinalysis looking for . . .

You will be given results if relevant to the discussion, then asked to 'present your findings so far'. At this point you can wait for the questions to come one by one or you can anticipate them and keep going until stopped. The examiners will commonly follow with the pattern of asking about possibilities, the likelihood of each possibility, the rationale for and against each, and confirmation for and against each.

The following is an example of how to respond in a manner that demonstrates your knowledge and understanding of the clinical signs and displays your ability to be a 'real' FACEM. Read it first with the questions being asked and then again with the questions removed. An excellent candidate will progress through each aspect of questioning without being prompted by the examiners' questions.

'Present your findings so far.'

Mr Jones is a well-looking man comfortable at rest and in no distress. He has no peripheral stigmata of disease. His pulse rate is 80 beats per minute, regular, full volume and tapping in nature at the wrist. Blood pressure was given at 160/70, and JVP is normal. Central pulses confirm the full volume. Praecordial examination demonstrates a well-localised apex beat displaced 2 cm lateral to the mid-clavicular line. There is a suggestion of a left ventricular heave with no thrill palpable. Auscultation reveals a mixed murmur heard loudest in the aortic area with radiation to the carotids but also well heard at the apex. Both heart sounds are heard with normal splitting. The diastolic murmur was loudest on sitting forward on exhalation with no appreciable change during the respiratory cycle. There is no evidence of cardiac failure and the liver is not pulsatile.

'Can you put these findings together?'

The mixed murmur has a number of possible diagnoses. I believe the most likely is mixed aortic valve disease with aortic incompetence as the dominant lesion, given the large pulse pressure and collapsing nature of the pulse.

'What else could it be?'

A number of other possibilities can account for these murmurs. The diastolic component could be due to mitral stenosis or less commonly tricuspid stenosis or pulmonary incompetence. The systolic component could be due to mitral or tricuspid incompetence, pulmonary stenosis or a pulmonary or aortic flow murmur. VSD or ASD could also cause systolic murmurs, and to-and-fro murmurs can be caused by more complex lesions such as coarctation or anatomical abnormalities including transposition of vessels.

'What supports one differential over another?'

In this age group, without signs of surgical intervention and in a well patient the likelihood of coarctation is remote. This would be a more common consideration in young children and evidenced by radiofemoral delay. I don't think the murmurs were louder with inspiration, making right-sided valvular lesions less likely. Mitral valve lesions are best heard at the apex, whereas this murmur was loudest at the base. However, it was well heard at the apex, which may represent an Austin Flint murmur. Of note, Mr Jones is in sinus rhythm. This would be unusual for mitral valve lesions where AF is more likely. Both heart sounds were well heard, which is also against significant mitral incompetence; however, this would still be an important differential diagnosis.

Other conditions such as VSD are possible, but these are usually well localised, mostly systolic only and would not be expected to be associated with such a large pulse pressure. It would be unusual for a diastolic murmur to be present with HOCM and this is also effectively ruled out by the systolic murmur increasing with isometric exercise.

'What else could you do to clarify things further?'

After completing the physical examination, the key initial investigations will be an ECG and chest X-ray. The ECG will confirm sinus rhythm and may demonstrate left ventricular hypertrophy. The chest X-ray may show valvular calcification, dilation of the

left atrium if there is mitral valve disease and I expect it will also reveal enlargement of the left ventricle and absence of cardiac failure.

The definitive investigation is echocardiography. This will confirm the diagnosis, the degree of incompetence or stenosis, the flow gradient, the size of the left ventricle and the ejection fraction and determine whether the aortic valve is tri- or bicuspid.

'Are there any features suggesting a specific aetiology?'

If you have been following the path of questions above, the bell may have gone by now. If you took the initiative and led the discussion, the time saved may have created an opportunity to score some bonus marks.

If you are confident of the diagnosis, as an alternative approach to the presentation, you could start by providing your diagnostic assessment and then present the findings that support this condition and exclude the major differential diagnoses. In that case, you can also take a different tack when the examiners stop you and ask 'what else would you like to examine?' and make sure you get these responses in from the outset:

Mr Jones has features of aortic incompetence. As well as completing my usual cardiovascular system examination I would like to additionally check for DeMusset's head-nodding sign and Quinke's sign of nail-bed capillary pulsation, measure the blood pressure in both arms for evidence of aortic dissection, check for Argyll-Robertson pupils of tertiary syphilis and for a high arched palate and check for increased joint mobility of collagen disorders such as Marfan's syndrome.

The cardiovascular system examination is particularly well suited to prepared responses that allow you to demonstrate your knowledge and differential diagnosis. Make sure that you know the features of all the valvular lesions including indications of severity. Do not omit VSD, ASD, HOCM, coarctation of the aorta and congenital malformations. Once you are familiar with the list of differentials for various murmurs and changes in heart sounds, having a discussion or presentation along the lines of the above dialogue will become increasingly easy.

Neurological system examination

Cranial nerves

If no specific direction is given, go through in numerical order. Occasionally, you will be directed to the 'lower' cranial nerves, in which case you should start from the end (CN XII) and work backwards. If the examiners wish to focus on a particular area, they will direct you accordingly.

Patients are best positioned sitting with their head at equal height to yours. This can mean sitting on a chair (which may find you crouching down) or on the side of the bed. Introduce yourself to the patient and remember to use the patient's name. Position the patient appropriately: *Mr Jones, could you please sit facing me with your legs over the side of the bed? Let your hands rest in your lap.*

Enquire, *Mr Jones, are you sore anywhere?*, to ensure that you will be able to proceed with your examination in the usual manner. Then take a step back to make the same general observations as with any other system examination. Ptosis from Horner's syndrome or a third nerve lesion, facial droop with absence of a smile from facial nerve lesions, neck masses and so on are all more obvious when you step back. If there is a clear abnormality, say so.

CN I: olfactory nerve

CN I is rarely tested. Asking the patient, *Can you smell normally?*, is generally sufficient.

CN II: optic nerve

Acuity

Have your visual acuity chart prepared with the same print on both sides. Make sure that you know the distance specified on the chart (usually an arm's length). Ask the patient whether they wear glasses and, if they do, check uncorrected vision first, corrected later. Ask the patient to cover one eye and hold the chart in front of the patient. Ask: *What is the lowest line you can read?* Then check the other eye.

Acuity is recorded as the lowest line the patient can read and includes the number of mistakes. For example, 6/12 – 2 indicates that the patient is able to read the 6/12 line but with two errors. If the patient is unable to read the top line, move forward until they can, recording the distance at which the 60 line becomes visible. If they still can't read it, check for movement, then light perception.

Visual fields

Face the patient. Hold the hatpin between you and ask, *Can you see the pin?* Then ask the patient to cover their left eye while you cover or close your right eye. Use the hatpin to come in from each quadrant in turn. Tell the patient: *Keep looking straight at me. Tell me when you first see the pin out of the corner of your eye.*

Use your own fields as 'normal' to identify restrictions in the patient's fields. Find the blind spot, estimating its size. Ask: *Tell me when the pin disappears.* Once it does, ask: *And tell me when it comes back.*

Repeat the same process for the other side. Note whether one or both blind spots are abnormally large (consider papilloedema, optic neuritis). Understanding the visual pathway anatomy is crucial to localising lesions (see Figure 6.1). Table 6.1 illustrates the principal abnormalities that may be encountered.

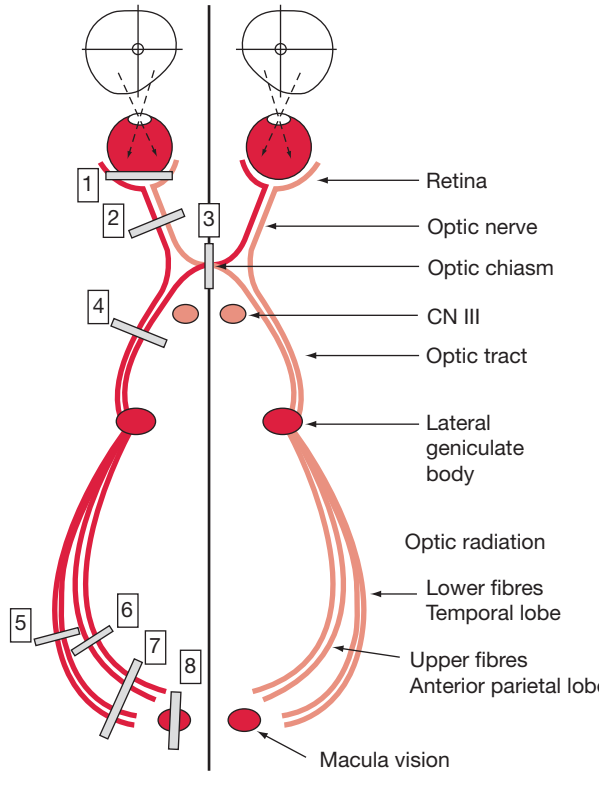
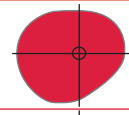
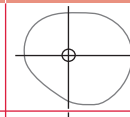
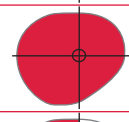
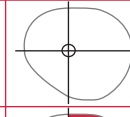
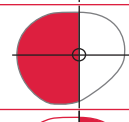
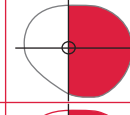
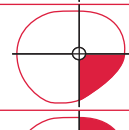
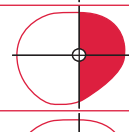
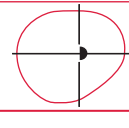
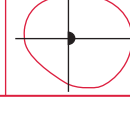


Figure 6.1 The visual pathway anatomy

TABLE 6.1 Visual field defects

Region	Left	Right	Comment
1 Retina			Affected eye will still have consensual light reflex
2 Optic nerve			Loss of consensual light reflex
3 Optic chiasm			Bitemporal hemianopia
4 Optic radiation			Right field hemianopia
5 Optic radiation —lower fibres			Right upper quadrant loss with macula sparing
6 Optic radiation —upper fibres			Right lower quadrant loss with macula sparing
7 Occipital cortex			Right field hemianopia with macula sparing
8 Macular visual region			Right field macula loss

Fundi

Ask the examiners, *Would you like me to examine the fundi?* Occasionally you will be asked to do so. Get used to examining the patient's right eye with your right eye and the patient's left eye with your left eye. If you are able to use the ophthalmoscope with either hand, this will reduce the chances of you tilting your head in the path of the patient. Tell the patient: *I'm going to look at the back of your eyes now. Could you please look straight at that corner?* [pointing with the ophthalmoscope light]

Do not ask the patient to look at a light source or the pupils will constrict. Advise: *Blink if you need to, but keep looking there so I don't have a moving target. If my head gets in the way, try to still keep looking at the same spot.*

Once the red reflex is found, move in and examine the optic disc. Follow the vessels out peripherally noting any pathology. Specifically look for haemorrhages, silver wiring and venous pulsation. Check the macula last of all by asking the patient to look at the light.

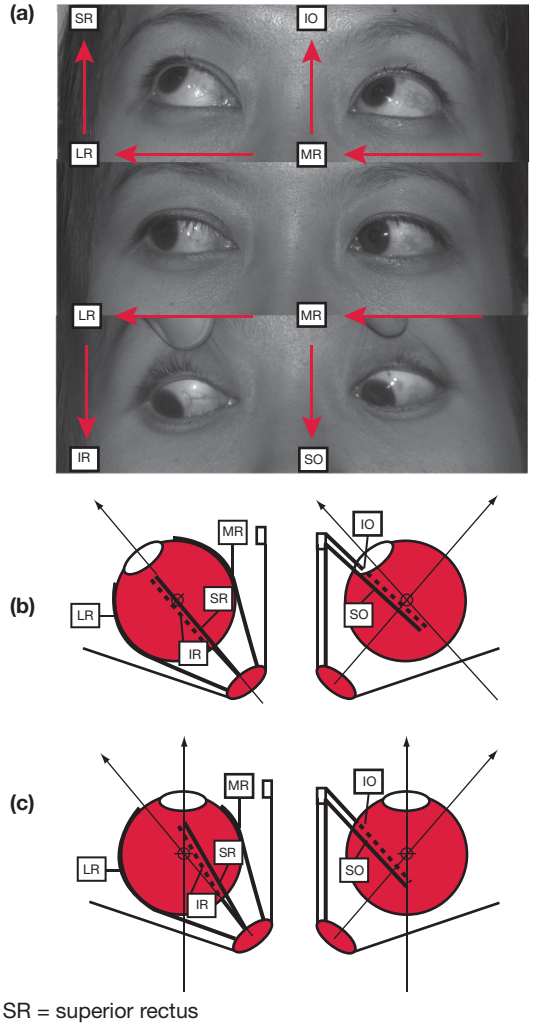
CN III, IV and VI: oculomotor, trochlear and abducens nerves

- *oculomotor* = moving the eye
- *trochlear* = acts via a trochlear attachment
- *abducens* = abducting

Eye movements tend to confuse those who have forgotten their anatomy (or never learned it in the first place). Understanding anatomy is fundamental to appreciating why the 'direction of action' of some muscles is almost the opposite of the direction

in which they are tested. Figure 6.2 will refresh your memory. The photographs and diagrams demonstrate the muscles involved when testing eye movements.

The key is to consider the difference between the alignment of the resting visual axis (forward), the line of the orbits (out at an angle) and the angle of pull of the extraocular muscles in relation to these. These align with the eyes deviated ~45 degrees and this is why we test up and down gaze in this position. The oblique muscles insert posterior to the rotational axis of the globe. Acting on their own as an individual muscle in the resting position, they each abduct the globe. The superior oblique will also cause the



SR = superior rectus
LR = lateral rectus
IR = inferior rectus
MR = medial rectus
IO = inferior oblique
SO = superior oblique

Arrowed lines represent the visual axis and axis of the orbit

Figure 6.2 Anatomy of the extraocular muscles
(a) Muscles tested with eye movements
(b) Anatomy of extraocular muscles testing eye movements
(c) Anatomy of extraocular muscles in neutral position

eye to look down and internally tort. The inferior oblique has the opposite effects. However, when the eye is adducted, the visual axis is aligned with the direction of pull of the obliques and so their actions are reduced to simply causing the eye to look up (inferior oblique) or down (superior oblique).

The same consideration applies to the superior and inferior rectus muscles — acting as isolated muscles in the neutral position, they each adduct the eye. However, they are tested with the eye abducted (aligning the pull of the muscles with the visual axis) by their ability to move the abducted eye up (superior) or down (inferior).

Once you have mastered this anatomy, practise drawing it and showing/teaching it to junior staff and medical students. A summary of the functions and innervations of the individual extraocular muscles is provided in Table 6.2.

Extraocular muscles

With the hatpin (or ophthalmoscope) still in hand from testing CN II, now is the time to test eye movements. Using an ophthalmoscope has the advantages of producing a light for the patient to focus on, a light reflection that highlights minor deviation between the eyes and a ready light source for testing pupil light responses, and keeps it poised if you have not examined the fundi and the examiners wish to direct you that way. Alternatively, use your torch. Do not shine the light directly at the patient's eyes as this 'blinds' them and causes pupil constriction. Aim for the mid forehead level so you can see the light is still on. You can use your finger instead of the pin but it looks less 'slick' and, unless you hold it perfectly vertically, the patient may report diplopic images 'at an angle' when they are not.

If there is ptosis, you may need to hold the upper lids open. Even without ptosis, this does make abnormality of eye movement more obvious and so is a good technique to practise. Tell the patient: *Keep looking at the pin* [or light]. *Tell me if you see double.*

Move the pin from one side to the other holding it at each side (medial and lateral recti). Check for correct movement and nystagmus. The light reflection in the pupils is a sensitive test of misalignment if the patient fails to report diplopia.

Next move the pin out to one side and test up (and hold it to confirm both sides have moved) and down (holding and checking again). Referring back to our anatomy

TABLE 6.2 Extraocular muscles

Muscle	Action in neutral position (acting in isolation)	Action to test function	Innervation
Lateral rectus (LR)	Abduction only	Look out	VI
Medial rectus (MR)	Abduction only	Look in	III
Inferior rectus (IR)	Adduction Depression External torsion	Look down when looking out	III
Superior rectus (SR)	Adduction Elevation Internal torsion	Look up when looking out	III
Inferior oblique (IO)	Abduction Elevation External torsion	Look up when looking in	III
Superior oblique (SO)	Abduction Depression Internal torsion	Look down when looking in	IV

discussion, this is testing the various obliques and recti. Move the pin to the other side. Repeat the up and then down movements.

If diplopia occurs, enquire about the orientation of the images: *Are they side by side or at an angle or above each other?* The direction of gaze where the diplopia occurs or is maximal indicates the muscle involved. If there is any doubt which eye is the cause, cover one eye and ask: *When I cover this eye, does the inside or outside one disappear?* The outer image is always from the eye with the palsy.

If a disorder of gaze is observed, test each eye individually with the other covered. This is important for several reasons. First, it allows you to concentrate on one eye, reducing confusion as you try to remember the anatomy of both eyes at the same time. Second, it confirms which eye has the abnormality. Finally, it reveals disorders of conjugate gaze that may be confused with medial and lateral recti palsies in particular.

Pupils

Examine the following:

- *Size:* check equality and estimate size in millimetres. Your acuity chart may have pupil size on it.
- *Shape:* irregular pupils may be due to trauma (including surgery), adhesions from past iritis or neurosyphilis.
- *Light response:* instruct the patient to look straight at you while you shine the light from the side. Swing the light in from the side so it does not obstruct your view. Do it twice for each side. The first time look for constriction of that pupil (direct reflex). Pause long enough to watch it dilate again. The second time, observe constriction of the other pupil (consensual reflex). Finish by 'swinging' the light between the patient's eyes, observing the contraction of each as light is shone in it. Afferent pupil defects will become obvious only when this is done.
- *Accommodation:* hold your pin/ophthalmoscope at an arm's stretch away from the patient. Tell them to keep looking at the light (or pin). As you bring it in, watch for convergent gaze and pupil constriction accompanying it.

Disorders

Common causes of disorders of eye movement include trauma and multiple sclerosis. Consider also CNS lesions including tumours, vascular malformations and brain stem strokes. A variety of neuromuscular disorders, as well as lesions of CN III and the sympathetic nervous system can cause ptosis.

- *Nystagmus:* this is expected in normal individuals on extreme lateral gaze where it is brief. Only test lateral gaze to 45 degrees. Where one direction of nystagmus is faster, it is named in that direction. Learn a list of causes for horizontal and rotary nystagmus. Find a colleague who is very short-sighted and practise testing ocular movements on them without their glasses/contact lenses. Rotatory nystagmus should be expected.
- *Horner's syndrome:* sympathetic innervation of part of the levator palpebrae superioris (raiser of the upper lid) causes ptosis, which is usually incomplete. Ocular movements are preserved, which differentiates this from a lesion of CN III. Look for the other features resulting from sympathetic loss on that side of the face: a constricted pupil (miosis), lack of sweating (anhidrosis) and sunken eye (enophthalmos). If present, follow the anatomical path of the sympathetic fibres backwards along the arteries (ophthalmic, carotids), root of neck/apex of lung (stellate ganglion) and back to the origin from T1. Proximal lesions will have the full complex, whereas orbital lesions will lack facial anhidrosis. Lesions of the lateral spinal cord (syringomyelia), brain stem (lateral medullary syndrome) or cerebral cortex will have other neurological features.

- *CN VI:* isolated lesions can cause a failure of abduction of the affected eye. Palsies of this nerve are not uncommon as CN VI has the longest intracranial course and is therefore subject to compression at multiple locations. Its crossed origin may lead to *false localising signs* with a diversity of conditions causing raised intracranial pressure.
- *CN IV:* isolated lesions of CN IV are uncommon but possible. The superior oblique has little influence on the resting eye and hence there is usually no obvious palsy on initial inspection. It becomes apparent with an inability for the adducted eye to look down.
- *CN III:* the upper eyelid and most of the extraocular muscles are supplied by CN III. Lesions may be complete or partial. In the resting position a complete lesion causes a prominent ptosis with the eye being pulled by the unopposed actions of CN IV (down and out) and CN VI (out). Partial lesions can be clarified by 'adding together' individual muscle defects.
- *CN III and IV:* an interesting challenge is to determine the presence of a CN IV nerve defect in the presence of a complete CN III defect. Remember that the adducted eye looking up tests CN IV, but a lesion of CN III makes adduction impossible! The solution: simply ask the patient to look to the other side. Although adduction is not possible, the superior oblique, acting on its own, will internally tort the eye. Inward rotation of the eye on attempted adduction confirms that CN IV is intact. Knowledge of anatomy is a wonderful thing!
- *Internuclear ophthalmoplegia (INO):* lesions of the medial longitudinal fasciculus cause an inability of adduction on the side of the lesion and nystagmus in the abducting eye. This is often bilateral and is almost always caused by multiple sclerosis. INO simulates medial recti palsies when both eyes are tested together. However, the astute clinician will test each eye individually while the other is closed, confirming the medial recti function (normal adduction) is intact and the condition is limited to a disorder of conjugate gaze — not a cranial nerve or extraocular muscle lesion. Bizarre defects of all three nerves may be seen in Wernicke's encephalopathy, a syndrome caused by thiamine deficiency. It is characterised by a triad of ataxia, ophthalmoplegia and impaired short-term memory. A true unilateral INO has been described in this condition.

  Bilateral defects in lateral gaze during conjugate eye movement (with nystagmus of the adducting eye) are most often associated with excess alcohol consumption and represent another form of INO. Normal abduction when testing eyes individually differentiates INO from bilateral CN VI lesions.
- *Argyll-Robertson pupil:* the pupil reaction associated with neurosyphilis is due to a defect in the Edinger-Westphal nucleus near the nucleus for CN III and results from dissociation of the accommodation and light reflexes. The easiest way to remember the lesion is with the aide memoir: just like contracting the syphilis, the pupil accommodates nicely but does not react well to light!
- *Holmes-Adie syndrome:* this is due to a defect in the parasympathetic pathway. The parasympathetic fibres originate in the Edinger-Westphal nucleus near the origin of CN III and travel in the periphery of the optic nerve. They leave the nerve prior to reaching the globe and are distributed within the orbit via the ciliary ganglion. Interference with the parasympathetic pathway results in a dilated pupil, with reduced or absent light and accommodation reflexes. It may also be associated with other features, including decreased tendon reflexes.

  Because of their peripheral location in the optic nerve, pressure on the nerve will often cause loss of parasympathetic function (dilated pupil) prior to visual defects. This is a classic finding with compression from a berry aneurysm.

  Of note, lesions of the visual pathway posterior to the Edinger-Westphal nucleus will have intact pupil reflexes.

- *Marcus-Gunn pupil:* disorders of the visual pathway anterior to the chiasm (afferent defects) can be caused by retinal or optic nerve lesions. Light perception is not relayed and so no light reflex occurs. However, a consensual response mediated via the parasympathetic fibres will cause constriction if the lesion is retinal or involves the optic nerve distal to the point at which the parasympathetic fibres depart the optic nerve. The good eye has both light reflexes; the one with the afferent defect only a consensual response. When a light is shone in the eye with the afferent defect, neither the ipsilateral pupil nor the contralateral pupil will constrict. However, the pupil will constrict from light in the other eye. 'Swinging' the light from one side to the other will cause constriction of both pupils when light is shone in the 'good' eye, but no constriction when shone in the eye with the afferent defect. As the light is swung from side to side, the 'good' pupil constricts relative to the one with the afferent defect. In particular, the side with the afferent defect will appear to dilate while the light is shone in it as it recovers from the constriction triggered by the previous consensual response.

CN V: trigeminal nerve

Named for the three sensory branches, it has a motor component as well.

Sensation

Begin by testing light touch. As you dab (not stroke) cotton wool on an area expected to have normal sensation, such as the upper sternum, explain: *This is a piece of cotton wool. Can you feel this? Close your eyes. Say 'yes' when you feel me touch you.*

Test the mid forehead on each side (V1), over the infraorbital region (V2) and the jaw below the outer border of the mouth (V3). These are roughly in a line that also coincides with the foraminal openings.

Test pin-prick sensation next. As you dab the pin against the same 'test' area as before, explain: *This is a specially blunted pin that won't hurt your skin. Is this sharp?* Then, as you dab the blunted side, tell the patient: *This is dull.* Explain: *Close your eyes. Say 'sharp' or 'dull' as I touch you.*

Test as for light touch. If a 'dull' response is consistently obtained or no response is obtained, go back over that area. For areas that are abnormal, ensure that you have tested 'sharp' and 'dull' to ensure the patient isn't simply saying 'sharp' or 'dull' to everything.

Motor

CN V supplies the muscles of mastication: masseter, temporalis and the pterygoids. It also supplies the tensor tympani and tensor palatini muscles, which are not normally tested. However, keep this in mind because defects of CN V will be associated with sensitivity to noise. This can be enquired about when the examiners ask what else you would do. It also explains why people clench their teeth and tighten their facial muscles (CN VII supplies stapedius) in response to loud noises.

Ask the patient to clench their teeth, and palpate the masseter and temporalis on each side. Get the patient to open their mouth, which will cause deviation to the side of weakness by the stronger pterygoids on the 'good' side. Finally, ask the patient to push against your hand while your hand is on the lateral jaw to test the pterygoids, confirming the side of weakness.

Taste

Although not often part of the examination, taste is easily tested with a salt sachet from the kitchen. Tear off the corner, dab the sachet on each side of the anterior two-thirds and posterior third of the tongue. Recall from your growing confidence with anatomy that taste sensation is derived from CN VII but the fibres travel with CN V after the

chorda tympani join it shortly after exiting the skull in front of the ear. Innervation of the tongue is summarised in Table 6.3.

TABLE 6.3 Innervation of the tongue

	Anterior two-thirds	Posterior one-third
Touch	V3	IX
Taste	VII (superior salivary nucleus via chorda tympani)	IX/X (inferior salivary nucleus)
Motor	XII	XII

Corneal reflex

The afferent limb is CN V; efferent is CN VII. Testing this reflex can be unpleasant if not necessary for the case, so before proceeding ask the examiners: *Would you like me to examine the corneal reflex?* Twist a corner of cotton wool and tell the patient: *I'm just going to gently touch the corner of your eye*. Use it to dab the lateral cornea, taking care not to enter the visual axis and to avoid touching the lids, both of which also cause the patient to blink. If there is no response, ask whether the patient is able to feel the cotton wool.

CN VII: facial nerve

Central causes (upper motor neuron lesions) are most commonly CVAs. Peripheral causes (lower motor neuron lesions) are typically Bell's palsy, trauma-related or part of a wider neuromuscular condition. Facial muscles are most easily tested 'top to bottom' with instructions such as:

- *Raise your eyebrows.* The frontalis muscle is innervated bilaterally at the upper motor neuron level. Paralysis of one side indicates a lower motor neuron cause. Central lesions are usually not associated with weakness of the frontalis.
- *Screw your eyes up tightly.* If the eyes do not close, you may see the globe roll upwards (Bell's phenomena).
- *Don't let me open your eyes.* Normal strength prevents you from opening the eyes with upward pressure.
- *Open your eyes and smile.*
- *Purse your lips.* or *Try to whistle.*
- *Puff out your cheeks.* Tap the cheeks to see whether they are weaker on one side or whether air escapes from the mouth.
  Taste can be tested if not done earlier.

CN VIII: auditory nerve

Hearing can be tested grossly by the ability to hear fingers rubbed or lightly flicked near each ear.

More sophisticated testing requires a tuning fork: 256 Hz is preferable but not essential.

- **Rinné's test:** prime the tuning fork by pulling it between gripped fingers. Do not bang it against your hand or other object, as this can set up odd harmonics. Hold it in front of one of the patient's ears and ask: *Can you hear that?* Place it over the mastoid and repeat the query. Move it back and forth and clarify: *Which is loudest, in front or behind?* Normally, air conduction is greater than bone. Bone is louder when there is a conductive loss on that side.
- **Weber's test:** place the primed tuning fork in the middle of the patient's forehead. Ask: *Do you hear that better on one side or in the middle?* The sound will be heard on the side of a conductive hearing loss or on the opposite side to a

sensorineural loss. Try humming yourself and occluding one ear to confirm the way a conductive deficit localises (to that side).

The combination of Rinné's and Weber's tests should enable you to decide the side and type of deficit of hearing loss.

CN IX and X: glossopharyngeal and vagus nerves

- *glossopharyngeal* = tongue and pharynx
- *vagus* = 'wandering', as the nerve does throughout the trunk

These nerves are tested together by palatal movements, gag reflex and sensation (touch and taste) to the posterior third of the tongue.

Ask the patient to open their mouth, and then shine a light inside. With a tongue depressor in hand ask the patient to say 'ahh'. Weakness is like a puppet with a string broken: the affected side does not elevate as well or at all.

Testing light touch on the posterior third of the tongue and gag reflex on either side can be done with the tongue depressor touching either side of the posterior tongue and tonsillar beds accordingly. However, this is unpleasant if function is intact. Practise the technique during your practice sessions, but on the day ask the examiners: *Would you like me to test the gag and posterior sensation?*

CN XI: accessory nerve

The accessory (to the vagus) nerve provides motor supply to the trapezius and sternocleidomastoid.

Ask the patient to turn their head to one side and hold it there as you push against them and feel the sternocleidomastoid muscle on the other side. Then test the other side.

CN XII: hypoglossal nerve

- *hypoglossal* = below the tongue

The muscles on either side of the tongue push it out. Weakness causes deviation to the abnormal side. Lower motor neuron lesions may be associated with fasciculations. Ask the patient to push out their tongue as far as they can. If there is no obvious deviation, ask them to push it to the left, then to the right.

Cerebellum

Common introductions include:

> **'Mr Jones has some difficulties with coordination [or gait]. Please examine this and anything else you find relevant.'**

Less commonly, the lead may refer to speech or balance. A common mnemonic for features to demonstrate is **DASHING**:

Dysdiadochokinesis
Ataxia
Slurred speech
Heel–shin
Intention tremor
Nystagmus
Gait (wide-based, positive Romberg sign).

Minimal postural changes to the patient make the examination appear much more professional. Therefore, it is best to *not* demonstrate these signs in the order of the mnemonic but rather to use the mnemonic to ensure that they are all part of the examination.

Verbal response gives you a rapid assessment of speech. Problems with ataxia and tremor may be obvious from the outset. If you are confident with the signs from the early stages, you may wish to present these and then indicate as you go what you are going to do and outline your findings. With this approach, the examiners, the patient and you all become more relaxed. A sufficiently trained patient may even start the motions when you describe what is coming next!

The following approach is suggested:

- Unless there is some obvious reason not to walk the patient, go for gold from the outset. Ask: *Is it okay for Mr Jones to walk?* If the answer is yes, proceed with the 'gait' examination. A wide-based, 'drunken' **ataxic gait** gives you a warm feeling inside knowing you are on the right track. When combined with the high-stepping, foot-slapping features of sensory deficit, you have almost diagnosed alcohol as a cause. However, do not assume that this is the only diagnosis as there are many causes of cerebellar dysfunction. Now would be a good time to describe exactly what you have just seen (or not seen, if this has excluded significant cerebellar dysfunction).

  Get the patient to sit on the bed with their legs dangling over the side.
- If **slurred speech** has not been identified, use the 'purple, turtle, lilac' approach (see the section 'Speech' later in the chapter).
- If **nystagmus** has not already been witnessed, demonstrate it on lateral gaze bilaterally.

  Dysdiadochokinesis is a sophisticated test. Remember the meaning of the word: *dys-* (abnormality of), *-diado-* (alternating), *-chokinesis* (rapid movement). Make your instructions brief while demonstrating: *Tap the back of your hand like this* [demonstrating with palm down], *now like this* [using dorsal surface] *and now back and forth like this as fast as you can. Okay, now let's do the same again with the other hand.*

  Because you test both sides, there is no need to say left or right initially and, if the patient has a 'good' side, they will generally use that side (or their dominant one) first. This minimises 'practise'. If there is a difference between sides ask: *Are you left- or right-handed?*
- **Intention tremor** (and past pointing) is best demonstrated by 'finger–nose' testing. Hold your finger in front of the patient's nose far but enough away that the patient needs to extend their arm most of the way to reach it: this maximises any tremor present. Now ask: *Touch my finger . . . Now your nose . . . Keep going back and forth.*

  Past pointing is maximal on the first cycle or two. After a few circuits when the patient has become comfortable, move your finger at the time they touch their nose to further demonstrate tremor and localisation difficulties. Then repeat: *Okay, now the other hand . . . Touch my finger . . . Now your nose . . . Keep going back and forth.*

By now you have demonstrated most cerebellar signs but still have a couple left. It may be time to start the discussion regarding synthesising your findings or, if you've already put it together, to start talking about possible causes. If you have been presenting your findings as you go, turn to the examiners and ask: *Would you like me to continue with reflexes and heel–shin?* If you have not been presenting your findings, the examiners may stop you at this point. When asked, **'What else would you do?'**, the answer in this case is completed with, *I would complete my examination by confirming other features of cerebellar dysfunction that I have not yet completed such as pendular reflexes and heel–shin testing.* This lets the examiners know there is more and gives them the option of proceeding or, being happy that your slick examination so far would only be continued, moving on to see how deep your differential diagnosis/causes list is. Otherwise, continue with your examination as follows:

- **Pendular reflexes** are pathognomonic for cerebellar disorders. Only use this term if you are happy with this diagnosis. Have the patient sit with their legs over the end of the bed, not touching the floor, and with their knees sufficiently off the bed to allow their legs to swing unimpeded. Tap the patella reflex without touching or holding the leg. In good cases, the leg will swing like a pendulum for several beats instead of the normal reaction of stopping after one. You will need to have seen this in practice to be convinced.
- The final section is the **heel–shin** test. If the patient is unable to walk, start in the supine position with this test (and complete the other components in the supine position, finishing with sitting the patient up for reflexes only if the patient is able). As always, instructions must be succinct and supplemented with a demonstration: *Put your heel on your knee, run it down to your foot . . . Lift it high in the air back up to your knee . . . Do it again . . . . and once more . . . Now the other side.*

  A good patient will already be trained, but a good technique will train any patient! If the patient has trouble following instructions, hold their foot and take it through the motions for the first circuit or two.

Discussion

There are many causes of cerebellar signs, with alcohol the most common in society. Learn a list of causes and be familiar with particular features of any you mention. Inherited disorders such as Friedreich's ataxia (autosomal recessive) are more common in examinations, particularly as they also have a number of other neurological signs (upper motor neuron signs with absent ankle jerks, optic atrophy, peripheral neuropathy), physical signs (pes cavus, cocked toes, kyphoscoliosis) and seemingly unrelated conditions (cardiomyopathy, diabetes mellitus). This creates a veritable 'field day' should you notice the other physical signs before the examiners ask the inevitable **'What else would you like to examine'** and **'What else could it be?'** Beware of diagnosing cerebellar pathology in patients with limb weakness, as any cause of paresis will impair the patient's ability to complete many of the tests.

Upper limbs

A variety of introductions can be used, usually non-descript such as:

> **'Mr Jones has some difficulties with [or weakness in or numbness in] his left arm. Please examine his upper limbs.'**

Alternatively, you may just be asked to examine the limbs or perform a neurological examination of the peripheries. The examiners will endeavour to make it very clear what they want you to examine. If you have any doubt at all, ask. The examiners will not let you proceed along the wrong path.

Upper limb neurological conditions may be related to trauma (including axillary injuries with scars not immediately obvious), generalised neurological disorders, myopathies or neuromuscular disorders forming part of a named complex. Conditions such as motor neuron disease, muscular dystrophies and peripheral neuropathies can all be found in neurology outpatient clinics and frequently are used for undergraduate and postgraduate examinations. Spend some time in the neurology clinics!

Essential anatomical knowledge includes myotomes, dermatomes, peripheral nerve distributions, and the brachial plexus and spinal cord pathways. The sympathetic trunk may also be involved with lower brachial plexus injuries.

Mastering the anatomy will enable you to differentiate between neuromuscular disorders, spinal lesions, brachial plexus injuries and peripheral nerve lesions. Learn the patterns of each. A useful starting point is to learn the features of a cord hemisection (Brown-Séquard), including which pathways are ipsilateral or

contralateral (depending on the level the fibres cross). Table 6.4 shows a cross-section of the spinal cord demonstrating the principal pathways, while Figure 6.3 presents a coronal representation of the major spinal cord pathways. Note that a lesion affecting one side of the spinal cord (Brown-Séquard syndrome) will result in paralysis and loss of proprioception and vibration sensation on the same side as the lesion, and loss of pain and temperature on the opposite side of the lesion. Once you have mastered the anatomy, learn the features of median, radial and ulna nerve lesions both proximal and distal.

Getting started

Patients are best positioned sitting with their head at an equal height to yours. Introduce yourself to the patient by shaking hands (which may demonstrate weakness or increased tone), and position the patient: *Mr Jones, could you please sit facing me with your legs over the side of the bed? Let your hands rest in your lap.*

In addition to positioning the patient, this may demonstrate any gross abnormality such as paresis as they 'assume the position'. Enquire, *Mr Jones, are you sore anywhere?*, to ensure you will be able to proceed with your examination in the usual manner.

Take a step back and observe the surrounds and the patient from a distance. Look for symmetry, wasting, tremor, fasciculations and abnormal posturing. After you have focused on the upper limbs, quickly scan the rest of the patient, including face and lower limbs. Occasionally you will be rewarded with a pattern that 'puts it all together'. For example, a patient whose arm is held in the 'tip taking position' and who has a wasted shoulder, tracheostomy scar and bicycle helmet but no other protective cycling gear can give you the diagnosis of upper brachial plexus injury (Erb-Duchenne palsy), most likely from trauma (traction), and associated with prolonged ventilation (tracheostomy) and head injury with poorly controlled epilepsy. If you can make this sort of diagnosis from the initial observation, you can also predict what you are likely to find.

After your inspection from a distance have a brief, closer look at the front and back of the patient's arms, neck and axilla (lift the arm) for any scars.

Motor examination

Power is best assessed starting proximally and working distally.

Rapid assessment

The following gives a rapid global assessment:

> Mr Jones, hold your arms out in front of you.
> Turn your palms up to the ceiling.
> Close your eyes and keep your arms there. [A drift will occur in the side with weakness.]
> Open your eyes and rest your hands back in your lap.

Observe for fasciculations. Lightly flick the arm and forearm muscles if there is any evidence of fasciculation to highlight this to the examiners.

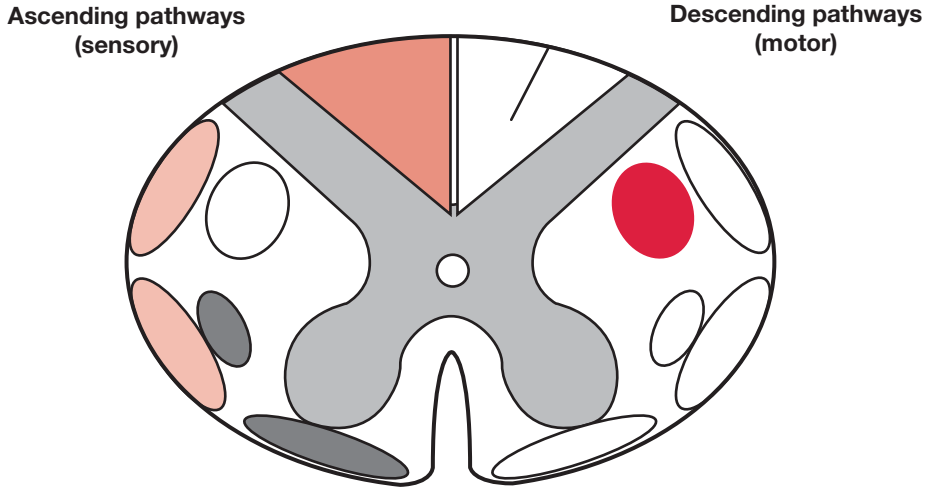
Tone

Check each arm for tone by holding the patient's hand in the 'handshake' position and gently 'shaking' the limb. If tone is increased, try to determine whether it is uniform or more pronounced proximally or distally.

Power

The technique is to get the patient to move if they can and then to push against you resisting. If power is limited, you may need to orientate the joint involved so that gravity is eliminated. For each joint, position the patient and then test power with the

TABLE 6.4 Spinal cord anatomy



Legend	Pathway	Modality	Level crossed	Comment
	Corticospinal (pyramidal)	Motor	Medulla (pyramids)	10% travel anteriorly and cross at spinal level
Not labelled anterior to corticospinal tracts	**Extrapyramidal**	Coordination, postural control	Not crossed	Multiple origins in brain stem
	Lateral spinothalamic	Pain, temperature, touch	As enters cord	Fibres directly lateral to central canal
	Anterior spinothalamic	Touch	As enters cord	Fibres directly anterior to central canal
	Posterior columns	Position sense, vibration, touch	Not crossed	Lower limb fibres medial, upper limb fibres lateral
	Posterior spinocerebellar	Balance	Not crossed	
	Anterior spinocerebellar	Balance	Cord level and cerebellum	Crosses over and then back again

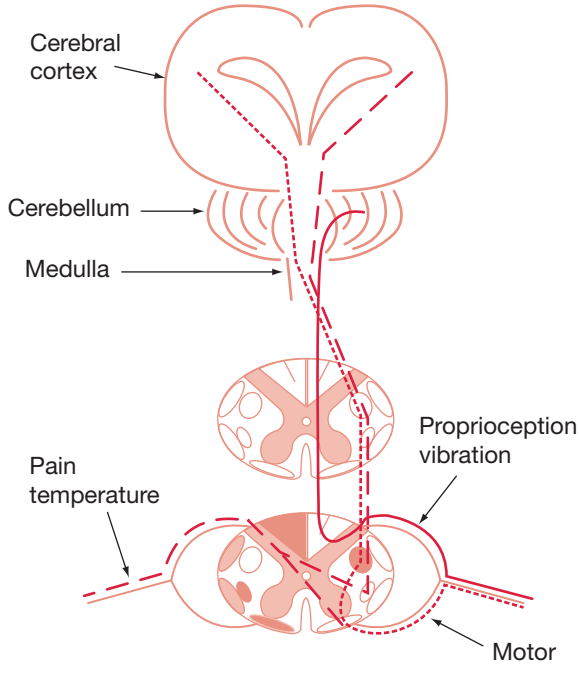


Figure 6.3 Coronal representation of major spinal cord pathways

instruction, *Push against me*, as you hold your hand at the end of the 'lever' so you have maximal ability to resist their movement. For some movements the instruction, *Stop me moving you*, will work better. Practise each and see which works best for you. Table 6.5 contains mixed examples of these instructions. Grade each muscle group as per Table 6.6.

Reflexes

Make sure the patient's arms are relaxed by asking the patient to rest them in their lap again. For the biceps (C5, 6) and supinator (C5, 6) jerks, a more consistent result is obtained by placing your thumb against the biceps tendon and your finger over the brachioradialis muscles and tapping your digit rather than tapping the patient directly. The triceps (C7, 8) reflex is best elicited by tapping the tendon directly.

If the reflexes are brisk, you can demonstrate this firstly by tapping more softly with the hammer and then directly with your index finger. You may also choose to demonstrate a finger jerk by flicking the DIP joint of the middle finger (Hoffman or finger flexion reflex). If this is also positive, you may be able to elicit clonus of the elbow and/or wrist joints.

If the reflexes are difficult to obtain, they can be 'reinforced' by getting the patient to clench their teeth just before you tap each one out.

Specific tests of the peripheral nerves in the hand

- **Ulnar nerve:** testing for finger abduction (C8, T1) — slide your eye chart between the patient's fingers, advising: *Keep your fingers straight. Bring them together. Stop me sliding this out.* Testing for Froment's sign, slide your eye chart between the patient's thumb and index finger, advising: *Grip this between the tips of your thumb and finger. Stop me sliding it out.* If the patient has to resort to 'pad-to-pad' pinch (thumb flexion from the flexor pollicis muscle), this sign is positive (due to weakness of the adductor pollicis muscle supplied by the ulnar nerve).

TABLE 6.5 Examination of upper limb myotomes

Myotome	Examination technique
Shoulder abduction (C5, 6)	*Mr Jones, lift your arms out to the side like chicken wings* [demonstrate] *Push against me* [with your hands on top of the elbows]
Shoulder adduction (C6, 7, 8)	*Bring your arms in to your side* *Push against me* [with your hands on the medial aspect of the elbow]
Elbow flexion (C5, 6)	*Pull your hands up to your shoulders* [position the palms in full supination] *Stop me moving you* [pull outwards on each arm in turn]
Elbow extension (C7, 8)	*Push against me* [with your hands on the back of each hand in turn]
Wrist flexion (C6, 7)	*Bend your wrists down* [demonstrating yourself with the arms held forward, fully prone with fingers clenched into a loose fist] *Stop me moving you*
Wrist extension (C7, 8)	*Now bend them up* *Stop me moving you*
Finger extension (C7, 8)	*Straighten your fingers* *Stop me moving you*
Finger flexion (C7, 8)	*Grip my finger* [offer only one finger to grip; two or more can be crushed. Attempt to slide your finger out]

TABLE 6.6 Grading muscle power

Power	Description
0	Nothing
1	Flicker
2	Movement but unable to overcome gravity
3	Able to overcome gravity, not resistance
4	Able to overcome some resistance, not normal strength
5	Normal

- **Median nerve:** the mnemonic LOAF describes the small muscles in the hand innervated by the median nerve:

  Lumbricals (usually two lateral)
  Opponens pollicis
  Abductor pollicis brevis
  Flexor pollicis brevis.

  With the patient's hand still supinated from testing Froment's sign, hold your finger directly above the patient's thumb and instruct them to touch your finger. Failure to abduct indicates a deficit (weakness of the abductor pollicis brevis muscle). Placing a coin on the table and asking the patient to pick it up tests both median nerve sensation and motor function (flexion, opposition).
- The **radial nerve** has no motor innervations in the hand.

Shoulder

If the signs are confined to the shoulder region, examine the patient from behind, specifically testing all movements of the shoulder (abduction, adduction, internal and external rotation, flexion, extension), and palpating the supra and infraspinatus muscles. Test for winging of the scapula (serratus anterior muscles) by asking the patient to push forward with outstretched hands and palpate the rhomboids when the patient attempts to pull the shoulder blades together at the back. From the front, inspect and palpate the sternal and clavicular heads of the pectoralis major muscle while pulling on a 'monkey grip'. After testing abduction, test sensation over the deltoid for evidence of axillary nerve deficit.

Sensory examination

Start initially with testing each dermatome, and test peripheral nerves subsequently. To recall the dermatomes, remind yourself of the brachial plexus arising from C5, C6, C7, C8, T1. The middle of these is also the supply for the middle finger (C7). If you hold your left hand up with fingers extended and touch your index finger to your thumb you make the number '6', reminding you C6 supplies that side of the hand and forearm. C8 supplies the other side and C5 and T1 supply the lateral and medial arm, respectively.

- C5 — lateral arm
- C6 — lateral wrist
- C7 — middle finger
- C8 — medial wrist
- T1 — medial arm

Instruct the patient to hold their arms in the anatomical position to bring the dermatomes into alignment for testing. Tell them, *Turn your hands out like this*, while demonstrating the anatomical position. Test light touch and pin-prick sensation as outlined in the cranial nerve section above.

Specific tests of the peripheral nerves in the hand

There is a large amount of overlap between the peripheral nerves. These areas are most consistently supplied by the following nerves, allowing you to limit your examination to the hand:

- **ulnar nerve:** ulna aspect of little finger
- **median nerve:** pad at tip of index finger
- **radial nerve:** on the dorsal surface, between the MCP joints of the thumb and index finger.

Vibration

Select your 128-Hz tuning fork and prime it as described earlier. Press it against the patient's sternum and ask: *Can you feel that buzz?* Once confirmed, begin testing by pressing on bony points starting distal — if negative, move proximally, and if normal, move on to position sense testing (see below). Begin with the dorsum of the thumb MCP joint. Tell the patient to close their eyes as you prime the tuning fork, then ask: *Tell me when you feel the buzz.* Once confirmed, ask: *Tell me when it stops.* Stop the tuning fork with your fingers after a brief interval to confirm what the patient is telling you. If necessary, test the ulna styloid and then the ulna olecranon.

Position sense

This is tested by holding either side of a joint, not top and bottom, as differences in light touch between the top and bottom 'give the game away'. Tell the patient, *Close your eyes*. Begin with a finger. Advise, *This is up*, followed by *This is down*, as you demonstrate the movement. Then ask: *Tell me which way I move it.* Lift up or down.

If there is no answer, prompt with: *Where is it now?* If proprioception is impaired at the fingers, repeat the procedure at the wrist and then elbow until a normal response is obtained.

Discussion

If there are multiple findings as you progress, it may be best to present them as you discover them. This approach ensures that you do not miss reporting any findings later. Presenting in the same logical sequence that you examined is an alternative (e.g. inspection, tone, power, reflexes, sensation). If you are confident with your findings, you should anticipate and consider your responses to the 'usual' questions.

'What else would you like to examine?'
You would like to complete the neurological examination including the lower limbs and whatever else seems relevant (e.g. cranial nerves, cerebellar function) as dictated by your findings. Looking at the base of the neck and lifting the arm to see the axilla are essential to identify scars from surgery or trauma and other lesions that may be the causes of the condition you have identified. If you are assured of the findings, you may suggest further examination that would confirm your diagnosis or provide other signs of causes or complications.

'Present your findings so far'
Only present relevant positives and negatives. If you have an overarching assessment (e.g. proximal myopathy, lower brachial plexus injury, distal ulnar nerve deficit) then start with this and support your assessment with the findings. If you have been presenting as you go, this question will not be asked.

'Can you put these findings together?'
Think whether it is possible to explain the findings with a single diagnosis. Sometimes there is more than one condition present, and some neurological conditions remain undiagnosed! The focus of this examination is more on your ability to examine and synthesise information than to come up with a specific (and particularly so if rare) diagnosis. Consider, however, whether the lesion is central (often bilateral, increased tone, increased reflexes, limited to motor or sensory modality loss or cerebellar signs) or peripheral (fasciculations, reduced tone, depressed or absent reflexes). If mixed motor and sensory lesions, consider whether it fits a cord level or peripheral nerve distribution.

'What else could it be?' and 'What supports one differential over another?'
Have a differential diagnosis list prepared for the various conditions.

'What else could you do to clarify the diagnosis further?'
Imaging is the most common answer. Plain films, CT and MRI may be indicated, depending on the likely lesion and location.

'Are there any features suggesting a specific aetiology?'
By this stage the question has most likely already been addressed.

Lower limbs

This examination and its introduction are similar to that for an upper limb neurological examination. A variety of introductions can be used, usually non-descript such as:

> **'Mr Jones has some difficulties with [or weakness in or numbness in] his left leg. Please examine his lower limbs.'**

Alternatively, you may just be asked to 'examine the legs'. If the introduction is, **'Mr Jones has difficulty walking'**, it is reasonable to ask to test this first.

Most of the conditions affecting the upper limbs can also present in the lower limbs. In addition, spinal cord lesions and complications from polio are more frequent in the lower limbs. Specific to the lower limbs are conditions associated with neural tube defects. You must ensure you look at the patient's back at some stage — the earlier the better.

As with the upper limbs, essential anatomical knowledge is fundamental. This includes myotomes, dermatomes, peripheral nerve distribution, and the lumbosacral plexus and spinal cord pathways.

Getting started

Begin in the same way as for the upper limb examination. The patient can either be supine or sitting with their legs over the side of the bed as for the upper limb examination. Practise both techniques, as some patients are not able to sit safely. Regardless of position, the patient's legs must be fully exposed, with modesty protected by underwear, a towel or both. Enquire, *Mr Jones, are you sore anywhere?*, to ensure you will be able to proceed with your examination in the usual manner.

Take a step back and observe the surrounds and the patient from a distance. Look for symmetry, wasting, tremor, fasciculations and abnormal posturing. After you have focused on the lower limbs, quickly scan the rest of the patient including their face and upper limbs.

After your inspection from a distance have a brief, closer look at the front of the legs, the back of the legs and the patient's back for any scars.

Motor examination

If possible, begin by asking: *May I see Mr Jones walk?* If your request is permitted, proceed with the gait examination. At the end of the gait examination, test ability to squat and rise (proximal myopathy). The detailed neurological examination can then follow. If your request is declined, proceed as follows.

Tone

With the patient supine, check each lower limb by ensuring it is relaxed and then briskly lift the knee slightly off the bed and observe how the leg follows. If tone is increased, try to determine whether it is uniform or more pronounced proximally or distally. For the sitting patient, test tone on each side by lifting the leg from below the knee in a similar fashion.

Power

Use the same technique as for the upper limbs, which is outlined in Table 6.7.

Reflexes

If the patient is supine, rest both knees on your arm to ensure they are relaxed, then tap over the patella tendon (knee L3, L4). Turn the leg out into a 'frog' position for the ankle jerk (S1, S2). It is helpful to cross the limb being tested to the other side so that the ankle is resting over the distal shin of the opposite leg. This makes it easier to access the tendon. Test the plantar response (S1) by running the blunt end of your pen or a key up the lateral aspect of the sole of the foot. Do not use sharp instruments that could cause pain and/or leave marks.

If the reflexes are brisk, demonstrate this as described for the upper limbs. Attempt to elicit clonus of the ankle and/or knee joints by brisk then sustained upward pressure on the soles and by downward pressure on the patella, respectively.

TABLE 6.7 Examination of lower limb myotomes

Myotome	Examination technique
Hip flexion (L2, L3)	*Push against me* [with your hands on the distal thigh]
Hip extension (L5, S1, S2)	*Stop me moving you* [as you attempt to lift from behind the distal thigh]
Hip abduction (L4, L5, S1)	*Push against me* [with your hands on the proximal outer thigh]
Hip adduction (L2, L3, L4)	*Stop me moving you* [as you resist with your hands on the medial thigh]
Knee flexion (L5, S1)	If supine, test with the knees bent up to 90 degrees *Push against me* [as you resist with your hands underneath the leg]
Knee extension (L3, L4)	If supine, test with the knees bent up to 90 degrees *Stop me moving you* [as you push with your hands on the front of the leg below the knee]
Ankle dorsiflexion (L4, L5)	If supine, test after extending the knee *Pull up against my hand* [as you press on the front of the foot]
Ankle plantar flexion (S1, S2)	If supine, test after extending the knee *Press down on my hand* [as you press up on the sole of the foot]

Similarly, if the reflexes are difficult to obtain, getting the patient to clench their teeth or make a 'monkey grip' and pull just before you tap each one out can 'reinforce' them.

Sensory examination

Start initially with testing each dermatome. Testing peripheral nerves is usually limited to foot sensation for the plantar nerves and differentiation between the superficial and deep branches of the common peroneal (tibial) nerve. The deep branch supplies the dorsal webspace between the hallux and second toe. Test light touch and pin-prick as recommended in the cranial nerve examination. Test the 'middle' of each dermatome in turn:

- L1 — groin
- L2 — anterior thigh
- L3 — over patella
- L4 — medial leg
- L5 — lateral leg, most of the dorsum of the foot
- S1 — lateral aspect of the dorsum and sole of the foot ('we stand on S1')
- S2 — back of leg
- S3, 4, 5 — form concentric rings verging on the anus (discuss with the examiner before testing these).

Vibration

Select your 128-Hz tuning fork, and prime and introduce it as described earlier. Begin with the dorsum of the hallux MCP. Test (if necessary) the lateral malleolus of the ankle, tibial tuberosity and finally the anterior superior iliac spine.

Position sense

Use the hallux. If proprioception is impaired, repeat the procedure at the ankle and then the knee until a normal response is obtained.

Discussion

If there are multiple findings as you go, it may be best to present them as you discover them. This approach ensures you do not miss reporting any finding later. If you are confident with your findings, you should anticipate and consider your responses to the 'usual' questions.

'What else would you like to examine?'

You would like to complete the neurological examination including the upper limbs and whatever else seems relevant (e.g. cranial nerves, cerebellar function) as dictated by your findings, including looking at the back if not already done. If you are confident of the findings you may suggest further examination that would confirm your diagnosis or provide other signs of causes or complications.

'Present your findings so far'

Only present relevant positives and negatives. If you have an overarching assessment (e.g. proximal myopathy, common peroneal (tibial) nerve deficit), then start with this and support your assessment with the findings. If you have been presenting as you go, this question will not be asked.

'Can you put these findings together?'

Think whether it is possible to explain the findings with a single diagnosis. Sometimes there is more than one condition present and again some neurological conditions remain undiagnosed! If operations have been performed involving tendon transfers, it may be extremely difficult to synthesise the findings. The focus of this examination is more on your ability to examine and synthesise information. Consider, as with the upper limb examination, whether the lesion is central or peripheral. If mixed motor and sensory lesions, consider whether it fits a cord level or peripheral nerve distribution.

'What else could it be?' and 'What supports one differential over another?'

Have a differential diagnosis list prepared for the various conditions.

'What else could you do to clarify things further?'

Imaging is again the most common response. Plain films, CT and MRI may be indicated depending on the likely lesion and location.

'Are there any features suggesting a specific aetiology?'

By this stage the question has most likely already been addressed.

Gait

A slick examination of gait is done with a single 'lap'. Walking the patient up and back several times is exhausting and time-consuming, looks disorganised and gives no more information than a single lap with efficient purpose. Do it once, do it right, and move on.

The patient should be bare footed with their legs fully displayed while preserving modesty. The patient's pyjama bottoms can stay on provided they are not in danger of tripping the patient, but will have to come off or up when examining the legs for a neurological examination.

Although the patient will generally be well trained by the time they see you, you should develop a technique that works for the uninitiated. Try it out in your everyday practice. The fewer words in your instructions, the better.

Mr Jones, could you please stand beside the bed?

Stand beside the patient. Identify a good place you can walk to in a straight line with room to walk alongside the patient all the way. Place one hand around and close to but not touching the patient's far shoulder to demonstrate that you can catch the patient if they become unstable.

Walk with me towards that corner [or whatever your chosen destination is].

After a few steps are taken, before you reach the half-way mark and without stopping, instruct: *Now one foot in front of the other, heel to toe*. [demonstrating yourself while giving the instruction].

Now stop. Turn around. Let's walk back.

As the first step is taken, instruct: *On your toes if you can* [for two or three steps] *and now on your heels*, which should then bring you back to the bedside.

Good. Now stand just in front of the bed and face me.

Ensure that the patient is close to but not touching the bed. This way they cannot fall backwards and you can safely demonstrate signs in front of them.

Put your arms by your sides and your heels together.

Observe whether the patient is able to stand unaided. If able, place a hand on either side of the patient's shoulders, near but not touching, to reassure both patient and the examiners and ask the patient to close their eyes. There is no need to give the patient a push as some medical students are taught. If the patient is unable to remain stable (positive Romberg test), this will be apparent within a few seconds. A positive Romberg test indicates impaired coordination. It is not a test of cerebellar function, although is often present in cerebellar disorders.

Learn to recognise the common patterns: the 'drunken gait' of cerebellar dysfunction; the high-stepping, foot-slapping gait of peripheral sensory loss (often caused by alcohol); antalgic gait (painful lesions); paretic gait (hemiparesis); the swing of a foot drop; and the shuffling Parkinsonian gait.

Parkinson's disease

You may be told the diagnosis or asked to assess gait or speech. When you introduce yourself and step back to observe the patient from a distance, you may notice a walking frame as well as these typical features:

- expressionless face
- absent blinking
- head bobbing (titubation)
- dribbling from the corner of the mouth
- paucity of limb movement
- resting, pill-rolling tremor.

Ask the patient to state their full name and the day's date. The slow, quiet, monotonous voice is characteristic.

Test gait if permitted (most likely) or if directed. The slow, shuffling gait is characteristic, along with difficulty starting and freezing. Asking the patient to turn around suddenly and to stop and start highlights these.

Propulsion and retropulsion (inability to stop shuffling once 'pushed') are classical signs, but are high risk just to demonstrate during a stressful exam. Mention that these features would be expected and give the examiners the opportunity to decline: *I anticipate Mr Jones would demonstrate propulsion and retropulsion. Would you like me to demonstrate these?* This may give you points without risking unintentionally

pushing Mr Jones over in your exam-fuelled enthusiasm! Should the examiners think both Mr Jones and you are up to it, they will permit it.

After gait is assessed, demonstrate the remaining features:

- *tone:* 'lead pipe' or 'cog wheel' rigidity on wrist pronation/supination
- *tremor:* maximal at rest; disappears on finger–nose testing
- *dysdiadochokinesis:* will be present
- *facial features and speech:* comment on these if not already done
- *glabellar tap:* continuous blinking on tapping the forehead with your finger while ensuring your finger is not visible to the patient
- *micrographia:* writing will be small when the patient is asked to write a sentence.

Finish by testing for frontal lobe signs and progress to higher mental functions if time permits.

Speech

Disorders of speech can reflect difficulty with the mechanical movement (dysarthria) or content (dysphasia). Dysarthrias usually imply cranial nerve palsy, cerebellar dysfunction or some other mechanical disorder resulting from neuromuscular dysfunction, trauma or mass lesions. Dysphasias (or aphasia if no response) can be expressive, reflected as difficulties in naming objects (nominal dysphasia) or problems with perception (understanding instructions). Dysphasias are typically cortical in origin and may be associated with other neurological signs and symptoms, some of which may form a named syndrome. Some are more common and/or interesting than others and hence are more likely to come to your ED or turn up in the exam.

For example, Gerstmann's syndrome (dominant parietal lobe disorder) is a combination of:

Acalculia (difficulties with simple arithmetic)
Agraphia (writing difficulty)
Left–right disorientation
Finger agnosia (unable to name fingers).

These features may be recalled using the mnemonic AALF. If present, examine the visual fields for a right inferior quadrantanopia.

Getting started

Begin by asking the patient their full name and the day's date. This should give an indication of whether you are dealing with a dysarthria, a dysphasia or a disorder such as cerebellar dysfunction or Parkinson's disease.

Dysarthrias

Ask the patient to say 'purple, turtle, lilac'. Difficulties in saying individual words localise to the structure starting with the same letter: purple = pharynx; turtle = tongue; and lilac = larynx. Once a disorder is identified, progress to testing of the lower cranial nerves and cerebellum.

Dysphasias (or aphasia if no response)

Determine whether this is receptive, expressive, nominal or some other variety. Having already asked the patient to say 'purple, turtle, lilac', you will know whether there is a problem with reception. Present the patient with a pen. Ask: *What is this?* If there is no response (aphasia) or the wrong but a related word is given, progress to: *What do you do with it?* A fluent response with incorrect, often totally unrelated content suggests receptive dysphasia. Expressive dysphasia will be apparent if the patient seems to

understand the question but struggles to structure a fluent response. These individuals will subsequently be able to follow written instructions such as 'write your name' or 'close your eyes'. Nominal dysphasia will be detected by asking the patient to name a part of the pen, such as the nib or lid: they will be unable to do this.

Higher mental functions

'Mr Jones has difficulty with memory, please test his higher mental functions.'

If the introduction includes any specific features, this may provide clues regarding further examination after higher mental functions have been assessed.

Introduce yourself, shaking the patient's hand. Ask about hand dominance and use your standard start of: *Mr Jones, could you please state your full name and the date today.* This tests **orientation** and may indicate a **speech disorder** or give other clues how to proceed. If nothing is forthcoming to direct you specifically, test speech, memory and then the cortical lobes in turn.

Memory

Test short-term memory by asking the patient to recall three objects. Pick simple ones that everyone would know, such as cutlery and crockery items. Test immediate recall. Test long-term memory with general knowledge. 'Who is the Prime Minister?' sometimes produces interesting responses! At the end of the session do not forget to prompt for recall of the objects you asked the patient to remember.

Parietal lobe

Test the patient's ability to do up and undo buttons and ask them to demonstrate for you how they use a key, to look for apraxia.

Ask the patient to write their name in full. Follow by asking them to draw a clock, marking in the numbers and putting the hands at '20 past 8'. If they have difficulty with the clock, ask them to draw a house and then mark in a door, windows and a chimney. Observe for visual inattention.

Draw a five-point star and ask the patient to copy it to assess constructional apraxia. When doing this in clinical practice, label your and the patient's artwork so that those reading the notes later can assess your star-drawing ability as well as the patient's!

Test for nominal aphasia and all the features of Gerstmann's syndrome. Assess for sensory inattention by touching one of the patient's hands, then the other. They should identify you have done this; however, when both hands are simultaneously touched the patient will be unable to detect that you have done this on the affected side.

Evaluate the patient's ability to recognise numbers drawn on their palms (graphaesthesia) or identify objects with palpation with the eyes closed (stereognosis).

Frontal lobe

Practise your frontal lobe reflex testing on babies during your paediatric sessions:

- *palmar mental reflex:* contraction of ipsilateral mentalis muscle pulling the corner of the mouth down when the palm is firmly stroked
- *pout:* when the lips are tapped
- *rooting:* the mouth draws towards a finger stroked on the side of the mouth
- *grasp:* the patient will grasp and not let go of a finger stroked across the palm.

Asking the patient to explain a proverb such as 'a rolling stone gathers no moss' or 'people who live in glass houses shouldn't throw stones' tests abstract thinking. Proverbs are culturally specific so, if the patient does not understand these, ask whether they know any others. As you do this more often you will learn new ones. An associated expressive dysphasia may also make this difficult.

Finish by asking the patient to recall your three objects again to test five-minute recall.

Discussion

Wherever possible, try to find a unifying diagnosis or anatomical location of a lesion. When asked what you would like to do further, this will guide you. In most cases further neurological testing will be indicated, including visual fields, cranial nerves and limbs.

Respiratory system examination

Respiratory cases are in plentiful supply as most chronic respiratory conditions induce signs that do not go away (unless they are surgically removed or replaced with a transplant). As with the abdominal examination (in the next section), it is difficult to give anything other than a nondescript introduction without giving a localising clue. For the sake of brevity you will usually just be introduced and asked:

'Please examine Mr Jones' chest [or respiratory system].'

The prevalence of chronic respiratory disease in childhood makes a paediatric respiratory short case even more likely than a cardiac or neurological one.

Getting started

As always, introduce yourself to the patient and step back to survey the scene. The respiratory examination is one where there may well be clues waiting for you on the bedside table or scattered elsewhere: a walking frame, wheelchair, oxygen cylinder or oxygen on the patient, sputum mug, metered-dose inhaler and peak-flow meter are just some of the possible clues. If there is a sputum mug, ask to look inside it. If you have been doing short cases properly, you will have looked into quite a few of these and realised why examination of the sputum mug is part of the standard 'respiratory' ward round. If there is no mug present, you *must* ask if one is available. The contents will help you incredibly.

The respiratory examination is also one where much information can be obtained before laying hands on the patient. After positioning the patient in your preferred way (see below), the following approach is recommended, even if your instruction is to examine the chest. The examiners will move you on if they really do not want you to assess general function.

> Mr Jones, could you please put your arms out straight in front of you with your wrists bent back like this?

While the patient is poised and you are waiting to see whether asterixis (CO_2 retention) develops, you can check the patient's general appearance, count the respiratory rate, check for pursed-lip breathing and use of accessory muscles, and determine whether this level of exertion has any effect on the patient during the time it takes to count the respiratory rate.

> Thank you, Mr Jones. You can put your arms down now. When you're ready, please take a deep breath in and blow it out for as long and hard as you can.

Encourage them to keep going if it is prolonged and/or if effort appears to be less than full. In some patients this will precipitate a coughing episode, which further clarifies their condition and physiological reserve. If a cough has not been induced already, ask for one now. Have a tissue ready in case it is productive, in which case you now have sputum to examine.

Some candidates prefer to examine the patient sitting in bed normally, some prefer the patient to have their legs over the side or end, some examine the patient initially from behind and some prefer to have the patient seated in a chair. A chair may not always be available, so we encourage you to become familiar with examination on the bed as well. Use whichever works best for you, but become comfortable with alternatives in case the patient is unable to swing their legs over the side of the bed or sit in a chair.

Peripheries

Once again, the respiratory examination has great potential for peripheral stigmata. As well as signs already tested, clubbing can be caused by any malignant or chronic inflammatory pulmonary condition. The hallmarks are increased nail-bed sponginess and loss of the angle at the nail base — not just curvature of the nail, which can be a normal finding. Look for tar staining from smoking (check both hands), evidence of anaemia, cyanosis (which could be peripheral or central) and muscle wasting associated with chronic respiratory disease or malignancy (either cachexia or an apical tumour invading the lower roots of the brachial plexus).

Inspect the face for Horner's syndrome, anaemia or cyanosis (central). The voice may be harsh from smoking, hoarse from a recurrent laryngeal nerve injury or palsy, or oesophageal if a laryngectomy has been performed. The face and neck may also show the typical facies and buffalo hump from steroid excess.

Chest

The peripheral examination, although rewarding, does tend to take up some time. A substantial portion of the seven minutes may have passed before you get to the chest. For this reason, we recommend you maximise your time by examining first those areas that are likely to produce results.

Moving down from the face, check for cervical nodes, supraclavicular masses or nodes, the trachea for midline shift, whether the apex beat is palpable or displaced and whether there are any obvious scars on the front (e.g. from chest drains or thoracotomies). This gives information regarding upper and lower mediastinal shift, which, when combined with evidence or absence of surgery, indicates possible contractions, lobectomy or pneumonectomy.

At this point, you will gain more information from examining the back than the front, so proceed to the back. Some candidates instruct the patient to touch their elbows together to move the scapula laterally. In reality, this has little effect on the examination finding and is uncomfortable for the patient. Practise this technique if you find it aids your examination findings or become comfortable letting the patient adopt a position of ease, which usually involves placing their hands on their legs and splinting, a manoeuvre that also causes the scapula to move laterally but without discomfort. **Inspect** for scars again. Most surgical incisions are more prominent from behind and may not even be visible from in front.

Check **expansion** of the upper, mid and lower zones. Upper lobe expansion may best be assessed by looking over the patient's shoulders at the front of the chest, rather than from encircling the hands around the chest wall and observing their movement with breathing.

Percuss down both sides, remembering to check the axillae. Dullness should be described as 'stony' only in the presence of definite signs of a pleural effusion. Tactile fremitus is rarely contributory and not essential.

Check **breath sounds** carefully: *Mr Jones, take some breaths in and out through your mouth. They don't have to be too deep, but must be through your mouth.* If necessary, you can instruct them to take larger breaths if breath sounds are still hard to hear. Bronchial breath sounds are equal in volume during inspiration and expiration with

a pause in-between. Bronchial breath sounds result from solid material connecting larger airways with the lung periphery (consolidation, fibrosis including surgical scars, solid tumours). Tracheal breath sounds are 'bronchial' in nature.

Listen for **adventitial sounds**. Crackles that clear with coughing indicate exudative lesions with material that can be 'moved' (e.g. bronchitis, bronchiectasis). Non-clearing crackles indicate fixed obstructions (e.g. fibrosis, non-exudative alveolitis). Wheezes result from narrowed medium and small airways and are commonly seen with asthma, obstructive airways disease and acute bronchitis. They may be expiratory and/or inspiratory. Inspiratory stridor is due to extrapulmonary obstruction (larynx, trachea). Expiratory stridor is due to intrapulmonary large airway obstruction.

Rubs result from pleural friction. The sound is classically described as like wet ships' ropes stretching. Check out a nearby harbour if in doubt. Rubs are generally heard at the point of pleural separation due to fluid. Every patient with a pleural effusion will have a rub near its apex if you examine closely enough.

Vocal resonance is tested by auscultating while the patient speaks: *Mr Jones, say 'ninety nine' [or 'one'] every time I touch your chest*. Listen carefully in all areas including the axillae. Vocal resonance is increased by the same sound-conducting lesions that are associated with bronchial breathing, but may occur in the absence of bronchial breathing if larger airways are not involved.

Whispering pectoriloquey is the ability to hear a whispered 'ninety nine' (or 'one') clearly on auscultation. It is an eloquent sign resulting from the same circumstances that produce increased vocal resonance and bronchial breath sounds.

After examining the patient's back carefully, you are likely to have found most, if not all, the physical signs present. With practice, ensuring you listen once, listen carefully and move on, you will be able to complete the entire examination within seven minutes. If you have practised well and time permits, repeat the above sequence on the front of the chest. Mostly this will serve to reinforce the signs you have already elucidated, giving you time to 'put it all together'.

Discussion

The most common opening from the examiners will be as follows.

'What else would you like to examine?'

As well as going on to complete your peripheral examination (if you were confined to examining the chest), you would complete those components of the examination above that have not been done, take a set of observations paying particular attention to SaO_2 (this will usually be given when asked) and then proceed on to a full general examination. You may wish to do a Pemberton's test if a superior vena caval obstruction is possible (e.g. probable pulmonary malignancy). The detail you focus on will most often include a cardiovascular examination for evidence of cor pulmonale and can be directed towards specific conditions you have identified.

'Present your findings so far' and 'Can you put these findings together?'

Remember the patient's general appearance, your findings around the bed and evidence gathered from the peripheral examination. If you are able to produce an overarching diagnosis and feel comfortable justifying it, now would be the time to say so and then back it up. Stick to relevant positive and negatives rather than a blow-by-blow description of the detailed examination.

'What else could it be?' and 'What supports one differential over another?'

Use your pre-prepared and memorised lists of causes for clubbing, mediastinal shift, dullness to percussion, crackles that clear or not, bronchial breathing and so on to

differentiate between exudative, 'solid' and 'liquid' conditions. If you are unsure, going through this rationally with the examiners demonstrates your clinical acumen, which is what the examination is all about.

'What else could you do to clarify things further?' and 'Are there any features suggesting a specific aetiology?'
Formal respiratory function testing and a chest X-ray should be included in almost every answer. Further examination or investigation will help with the 'complications' and 'cause'. If all goes well, these final questions will have already been dealt with.

You may be shown a chest X-ray if it is either interesting or confirms your findings. Time constraints usually prevent this, although briefly being shown an image confirming your diagnosis of 'right middle lobe consolidation' is a nice way to finish off a respiratory short case.

Abdominal examination

It is difficult to begin with any introduction other than:

'This is Mr Jones. Please examine his abdomen [or gastrointestinal system].'

Any other introduction tends to give you too big a clue. If you are asked to examine the gastrointestinal system, start with a general and peripheral examination. If you are directed to the abdomen, focus on this, although a brief general examination is likely to be permitted. You will be stopped if you are taking too long to get to the abdomen. After completing the abdominal examination, you may wish to keep examining until you are interrupted, returning to the peripheries and performing a directed examination that is relevant to your major findings.

Getting started

Introduce yourself to the patient with a handshake, ensure that the patient is supine and comfortable, and enquire about any painful areas. You can now do this in your sleep (and may do). Take your well-practised step back. The surroundings may not offer many clues, but significant organomegaly is often visible on simple inspection from the other side of the room. In fact, it is often more easily appreciated from this distance.

Scan the patient for features of alcoholic liver disease or the cachexia of malignancy. Haemochromatosis ('bronzed diabetes') is more obviously abnormal pigmentation when viewed from a step back. Consider the degree of 'tan' relative to the local climate and time of year. Anaemia and/or jaundice may be apparent. If there is evidence of liver disease, ask the patient to hold their hands out with their wrists extended and check for asterixis ('liver flap' associated with hepatic failure).

Peripheries

Check the patient's hands for clubbing (malignancy, primary biliary cirrhosis, inflammatory bowel disease), anaemia, palmar erythema, Dupuytren's contractures and abnormal pigmentation of the palmar creases. The skin of the arm and trunk may show bruising, spider naevi or scratch marks indicating pruritus (consider obstructive jaundice).

Examine the sclera for anaemia or jaundice. The eyes may demonstrate Kayser-Fleisher rings indicating Wilson's disease. These signs are subtle and best appreciated after having seen them before (in clinics). Check for perioral pigmentation associated with Peutz-Jegher syndrome. Assess dental hygiene and look for glossitis and any other intra-oral abnormality.

On the way past the chest towards the abdomen, pause briefly to look for gynaecomastia and more spider naevi if you have not found the requisite five to be classified as abnormal. Demonstrate that they blanch then refill from the centre.

Abdomen

Continue inspection of the abdomen for scars, striae, a caput medusa and the generalised distension of ascites. It is easier to report these now as they are obvious, you may not have said anything for a while and this keeps the examiners 'tuned in', as well as ensuring you do not forget to present them later.

Crouch down to look horizontally across the abdomen. Ask the patient to take some breaths in and out. Significant organomegaly or other masses not appreciated previously may become obvious.

If possible, have warm hands (even if they are a bit clammy!). Remember whether any area was indicated as being tender and modify your palpation accordingly. Begin with light palpation of all four quadrants and lightly run your fingers across the abdomen. Peritoneal deposits are best appreciated by this manoeuvre and are easily missed with deeper palpation. After light palpation, deeper palpation will delineate any mass or organomegaly.

Specifically examine the liver, spleen and kidneys. Begin palpation of the liver in the lower quadrants, moving up with each breath until an edge is felt advancing against your hand. Follow the edge left and right as far as you can, evaluating texture, smoothness and edge for the portion palpable below the costal margin. Percuss out the upper margin and estimate the span, thus excluding simple ptosis.

Begin palpation of the spleen in the right lower quadrant. It should enlarge along the axis of the tenth rib towards the umbilicus, come down with respiration and have a notch. If the spleen is not palpable, position the patient on their right side and palpate again with one hand behind the patient's left lower ribs pulling the spleen forward. A spleen in a child is normally tippable. In an adult the normal anterior limit is the mid-axillary line: it must be twice normal size before becoming palpable.

If a mass is felt in the left flank, test for ballotment and percuss over it. Unlike the spleen, the kidney does not move with respiration and should ballot. In addition, the splenic flexure of the colon and/or stomach will create resonance to percussion over a kidney but not the spleen. An upper margin of the spleen will not be palpable, but you may be able to 'get above' a kidney. None of the signs differentiating between spleen and kidney are absolute, with the possible exception of the presence of a notch, making an 'overall' assessment of a left flank mass a matter of clinical judgement, not just a single feature. Ballot for a right-sided kidney with the patient supine, and percuss over any mass found.

After checking for organomegaly and defining any other masses that are palpable, test for ascites by the presence of a fluid thrill and shifting dullness. Both require the margin of dullness (fluid edge) to be determined initially in the supine position. Make a mental note of the position, but do *not* mark it — the examiners do not want evidence for subsequent candidates! A fluid thrill can be elicited by placing one hand over a flank ensuring it is over presumed fluid but not an organ. Tap the other side in the same position (fluid but not organ) with a finger. With fluid present, a percussion wave can be felt easily. This test can be made more sensitive by placing a hand in the middle of the abdomen to 'stabilise' it — however, this is not necessary and would require you to have a third hand or have one of the examiners leaning over the patient with you. Shifting dullness is elicited by rolling the patient onto their side after percussing the edge of the ascites and waiting preferably for a few minutes (although rarely does more than ~20 seconds pass) before percussing again to find the edge has moved posteriorly. Rolling the patient away from you makes it easier when subsequently percussing, as you will not have to lean over the patient.

Discussion

The examiners will usually stop you after you have examined the abdomen unless you have been particularly timely. If so, carry on as if the 'usual' questions were being asked.

'What else would you like to examine?'

You would like to examine the hernial orifices and testicles (in males) for size and abnormal lesions, complete a rectal examination including evaluation of the prostate (in males) and check for a rectal 'shelf'. You would like to check a urinalysis for bilirubin and evidence of infection, take a set of observations and then proceed to a full general examination. In particular, you would like to examine for evidence indicating conditions, causes and complications of what you have found so far. For example, an isolated, irregular firm hepatomegaly in a cachectic individual is metastatic disease until proven otherwise. Your further examination would therefore be focused on those organs that produce hepatic metastases (e.g. bowel, lung, kidneys, thyroid, prostate, melanoma).

'Present your findings so far' and 'Can you put these findings together?'

If you have an overarching diagnosis, present it first and then justify it. If not, give a systematic presentation of relative positives and negatives.

'What else could it be?'

You should have a pre-prepared list of causes of massive, moderate and mild hepatomegaly, splenomegaly and hepatosplenomegaly, as well as unilateral and bilateral kidney enlargement. The priority listing should take into account the individual patient rather than just regurgitating the 'list'.

'What supports one differential over another?'

As an example, this could relate to how the causes of a mass may be differentiated, particularly spleen versus liver.

'What else could you do to clarify things further?' and 'Are there any features suggesting a specific aetiology?'

Specific investigations may be needed (e.g. investigations to determine the cause of suspected obstructive jaundice would include LFTs including direct bilirubin, ultrasound of the liver and bile ducts, and a CT scan of the abdomen).

'Other' examinations

An almost endless variety of cases can be presented in the short cases. As well as those listed here, you should be familiar with assessment of hernias, ulcers, peripheral vascular disease, varicose veins, aortic and popliteal aneurysms and so on. Spend time in general and subspecialty surgical clinics!

Knee (orthopaedic)

Of the joints, the knee is the most likely to appear as a short case, although the general technique applies to other regions. Degenerative arthritis and ligamentous instability are the most likely conditions to be encountered. It is unlikely that you will be permitted to walk the patient at the beginning of the examination, although this should be requested. If granted, any functional deficit will be readily apparent. The general 'orthopaedic' approach should be adopted: look, feel, move, X-ray.

Look

Assuming you are not permitted to walk the patient, begin with the patient supine and their legs fully exposed, preserving modesty. Check for symmetry between the limbs, inspecting for wasting of the quadriceps, protuberances, effusions and skin lesions. In tense effusions, the knee will be held in the 'position of ease' flexed at 45 degrees. Scars may indicate corrective surgery or result from trauma.

Feel

After checking there is no pain, assess for heat by gentle palpation. Feel the joint margin for warmth and thickened synovium (a difficult sign to appreciate). Check for an effusion by 'milking' the suprapatella recess from the mid-thigh down to the patella. In the presence of an effusion, the patella can then be 'tapped' against the distal femur.

Move

Place one hand over the patella with your thumb and fingers extending over the medial and lateral joint margins. Gently flex the knee as far as the patient will permit. The hand on the patella and joint will appreciate **crepitus** in each of the three 'compartments' during this range of movement. Estimate (or measure) the degrees of flexion. Gently extend the knee, palpating for crepitus again until maximum extension is reached. 'Locking' is an inability to reach full extension. The most common causes are torn menisci, with the torn section folded over, or some other form of intra-articular foreign body. The normal knee will rest extended slightly beyond 180 degrees.

- **Collateral ligaments** are tested by flexing the patient's knee to ~30 degrees, placing one hand behind the knee to ensure the hamstrings are relaxed and then applying gentle varus and valgus stress.
- **Cruciate ligaments** are tested by flexing both the patient's knees to 90 degrees. Initially observe for any difference in the position of the tibia. Relative posterior movement indicates laxity or disruption of the posterior cruciate ligament. Fix one foot with your body, usually by sitting on it. Place one or both of your hands around the patient's knee with your thumb(s) on the tibial tuberosity and fingers posterior resting against the hamstrings, ensuring they are relaxed. Now attempt to 'draw' the tibia forward (anterior cruciate test) or backwards (posterior cruciate test). Compare with the other side to ensure that an anterior 'draw' sign was not simply a correction of a posteriorly displaced tibia back to normal.
- **Menisci** are tested by flexing the patient's knee fully and then extending while the foot is everted and then inverted (McMurray's test). Each manoeuvre tests the anterior and posterior horns of each meniscus at various points during the movement. The menisci can also be tested in the prone position with the knee flexed at 90 degrees. The leg is 'ground' down upon the distal femur. This test (Appley's grinding test) is rarely contributory to the clinical examination in ED.

X-ray

Radiographic imaging is the final stage of assessment of a joint. Features of osteoarthritis and rheumatoid arthritis should be well known. If a knee is presented as a short case, there should be time to examine and comment on plain films.

Rheumatoid hands

The most likely 'hand' to be presented, other than one with a neurological finding, is the rheumatoid hand. If specifically directed to the hand (the most likely scenario), do not start with a general examination. You will gain some appreciation of the overall status of the patient as you proceed, and can include this at the end of your examination

if presenting as you go (or at the start if you prefer to present later). Our advice is to present your findings as you go, as it is easy to omit certain findings if you are trying to remember too much. Develop a system to take you through each component of the pathology in a systematic fashion that 'scans' the hands, wrists and forearms.

Have the patient sitting on the edge of the bed or in a chair with the hands resting palm down on a pillow. It will be highly likely that a pillow will be beside the patient for this very purpose.

Look

Briefly scan the patient as you take a step back to observe in your usual fashion. If this is clearly a rheumatoid hand, let the examiners know you know the diagnosis: *Mr Jones has a symmetrical, deforming polyarthropathy of the wrists and hands.* You can now all relax as you provide the detail.

Comment first on the deformities of **position**. Ulnar wrist deviation and various combinations of DIP and PIP joint deformation forming 'Z' thumbs (shaped like the letter), 'boutonnière' (fingers that make the shape of a buttonhole when opposed) and 'swan neck' (fingers) deformities should be noted for each finger. Note subluxation of MCP joints.

Next, comment on any obvious **joint** irregularities. Subluxation of wrist and MCP joints with swelling of the PIP joints is to be expected in rheumatoid arthritis. Swelling predominantly in the DIP joints is more in keeping with osteoarthritis. Gout can produce tophi, which may extrude.

Note **wasting**, particularly of the thenar and interosseous muscles.

Examine the **skin** starting at the finger tips and moving proximally. Thin, shiny skin may be caused by the condition (e.g. scleroderma) or steroids used to treat it. Bruising, evidence of infection and scars are important. Scars over joints may represent replacements that have corrected the previous deformity.

Spend some time on the **nails**. Clubbing is uncommon but you may find evidence of anaemia, pitting (psoriatic arthropathy), ridging, curling and other deformities. Infarcts beneath or around the nails may indicate active vasculitis or be telangiectases associated with CREST syndrome.

Ask the patient to turn their hands over. Observe again for scars, redness, wasting and evidence of anaemia.

Feel

Feel each joint in the digits and wrists in turn. Note instability, swelling and warmth. Palpate the tendons for thickening.

Move

Test the range of movement in each joint. Begin by asking the patient to clench and open their hands a few times. Restricted movement and tendon entrapment (trigger fingers) will be obvious. If so, it may not be necessary to examine in finer detail.

Examine further

Unlike the 'orthopaedic' examination where you proceed to X-ray the joint next, the medical physician further evaluates the extent of disease. Initially evaluate the hands further by testing functional ability. Have a container with a key and coin inside that can be seen (these are useful in neurological testing). Assess the patient's ability to open the container and demonstrate the use of the key.

Continue with the examination beyond the requested area by moving up the arm. Feel for rheumatoid nodules (ulna surface) and look for rash. Indicate that you would go on to examine all the other limb joints (say this convincingly, because you may be taken up on the offer if time permits) and then proceed to a full physical examination.

The list of articular and extra-articular manifestations of rheumatoid arthritis is long. Mention the ones that are common and commonly potentially deadly from the emergency medicine perspective (reduced neck mobility with atlantoaxial instability may be fatal in over-judicious attempts at intubation). Presenting from the perspective of a FACEM instead of a general physician will count well in your favour.

X-ray

Now you can proceed to radiology of the joints. Make sue that you know how to differentiate rheumatoid from osteoarthritis on X-ray. Usually, but not always, there will be insufficient time to view X-rays.

Thyroid

This may be introduced as **'Mr Jones has a neck mass'** or simply **'Examine Mr Jones' neck'**.

Inspection

Stepping back and examining the patient may reveal an obvious goitre and the facies of hypothyroidism (thick skin, rosy cheeks, loss of outer third of eyebrow) or hyperthyroidism (exophthalmos). Observe for scars of previous surgery or prominent veins over the head from obstruction. When greeting the patient, ask whether their neck is tender and listen to their voice for evidence of recurrent laryngeal nerve palsy. Offer the patient a glass of water to swallow and observe upward movement of the thyroid gland.

Examination

If examining the patient from in front, place the thumb of one hand over one side of the thyroid while palpating with the other. If you prefer to examine from the back, gently palpate one side at a time. Assess symmetry of enlargement, nodularity, tenderness and any discrete lesions within the gland. Test a swallow again only if there is doubt this is a thyroid gland.

Check for extension of the thyroid into surrounding tissue (check carotid pulsation and the trachea for the midline position) ensuring the lower border can be palpated. It is possible to have accessory glands not connected to the main body given the course travelled by the gland in its embryological journey from the tongue through the neck. Check for surrounding lymph nodes. Listen for a bruit over the gland and the carotids (infiltration). The final part of examining the gland itself is to check for retrosternal extension. Do this by percussing over the sternum and then testing for Pemberton's sign (superior vena caval obstruction) by raising the patient's hands above their head.

After examining the thyroid itself, move on to the remaining Cs. If there is evidence of surgery that raises the possibility of inadvertent parathyroid removal, mention that you would like to check for signs of thyroid dysfunction and evidence of hypocalcaemia. If you have 'spotted' supporting evidence towards hypo- or hyperthyroidism, mention this specifically and direct your examination accordingly.

Hypocalcaemia may be detectable clinically by the presence of Chvostek's sign (tapping the facial nerve as it passes through the parotid gland causing focal facial muscle twitching) and Trousseau's sign (pumping a sphygmomanometer above systolic pressure causes the hand to spasm in the position of the 'obstetrician's hand' — *main d'acchoucheur*).

Hyperthyroidism will be evident by proptosis, lid lag and retraction, dry eyes and a variety of ophthalmoplegias if eye disease is associated (e.g. Grave's disease). Clubbing may be present along with an exaggerated physiological tremor, sweatiness, tachycardia, dysrhythmias and, in severe cases, cardiac failure. Moving down the body, check for proximal myopathy, pretibial myxoedema (thickened plaques over the tibia) and finally reflexes that are heightened.

Hypothyroidism is classically associated with loss of hair from the outer third of the eyebrow, xanthelasma and a slow, hoarse voice. Hair thinning and obesity are common. Examination of the peripheries may indicate anaemia and peripheral oedema. In the wrist this may lead to a positive Tinel's sign of carpal tunnel syndrome. The pulse is slow and low volume. Proximal myopathy is less common than with hyperthyroidism and the reflexes are 'hung up'. The ankle jerks demonstrate this best with a normal contraction but delayed relaxation phase. In severe cases, percussion myotonia will be present — tapping the calf muscles causes local contraction producing a hollow, which is then slow to relax and resolve.

For both hypo- and hyperthyroidism, proceed on to a full general examination starting with the neurological and cardiovascular systems.

Breasts

Breast examination may be part of a search for a source of a metastatic lesion or a paraneoplastic neurological condition. If there is only one breast, examination will focus on draining nodes from the removed side and then a thorough examination of the remaining breast.

Begin with the patient's arms by their side and relaxed in a semi-recumbent position. Inspect for asymmetry of the breast or nipple, dimpling of skin (*peau d'orange*), nipple discharge and pigmentation. Axillary nodes may be visible in this position.

Instruct the patient to place one hand behind their neck. This flattens out the breast, brings it to a consistent anatomical position and exposes the axilla for examination of draining lymph nodes. The movement may unmask tethering of deeper structures.

Examination

Warm your hands first. Using the flat of your hand systematically 'roll' your hand over each quadrant, ensuring complete coverage of the breast. Repeat this by placing one hand under the breast while the examining hand systematically covers the breast again. Specifically examine beneath the nipple and for discharge that can be extruded without undue pressure. Finish by examining the axilla in all sections for lymph nodes. Repeat for the other side.

If one breast has been removed, check the arm for evidence of lymphoedema. If a mastectomy has been performed or any lesion palpated, enquire about bony pain, check for rib tenderness, gently percuss over the length of the spine and examine for hepatomegaly, pleural effusions, superior vena caval compression and neurologic deficits suggesting brain metastases.

Lumps

Most 'lumps' can be addressed with a simple pattern, such as:

- site, size, shape
- colour, consistency, contour
- mobility, transillumination, draining nodes.

Practise this pattern on all lesions you see.

Pregnancy

Routine assessment of a pregnant patient, especially in the third trimester, should be within the scope of practice for a FACEM. Pregnancy is common, but some complications are commonly deadly. Remember:

- prior to 20 weeks = fetus
- after 20 weeks = baby.

Definitely introduce yourself with a smile. Adding 'congratulations' as part of your 'thanks for participating' doesn't hurt — and you might get a smile back! Check the patient is comfortable and mention the preferred position is wedged to the left (whether

already on the left or not). Note the patient's general appearance, skin colour (including skin pigmentation), and respiratory rate and effort.

Pregnancy-focused examination

- Features of pre-eclampsia:
  - ask for a blood pressure; anticipate being asked to measure it
  - look for evidence of oedema — ask whether rings still fit, check ankles and look for periorbital swelling
  - mention you would check the urine for protein.
- Estimate of gestation:
  - the fundal height is above the pelvic brim at 12 weeks, level with the umbilicus at 20 weeks and up to the costal margin (maximum height) at 38 weeks but drops 2–4 cm as the baby's head engages at term
  - a 'rule of thumb' is that the fundal height in centimetres above the symphysis is approximately equal to the number of weeks.
- Lie:
  - head and/or back may be palpable
  - ask where kicks are felt and/or comment if you feel kicks
  - exclude a breech position and identify whether the head is engaged if late pregnancy
  - consider multiple pregnancy if 'too many' parts are palpable.
- Assessment of baby:
  - check movement, kicks
  - check heart rate — use a Pinnard; if not heard, Doppler may help
  - formal ultrasound confirms single pregnancy, size, morphology, activity, placental lie and adequacy; can plot against normal references and estimate date of delivery; serial examinations confirm appropriate progress.

Neonate/baby check

'Routine' baby checks are performed on every newborn and therefore should be within the scope of practice for a FACEM. The neonate must be naked.

From the end of the bed

Look for:

- size (average weight at term is 3.5 kg)
- activity
- respiratory rate (40/min is normal), effort, recessions and sounds
- general colour — peripheral or central cyanosis, jaundice
- evidence of birth trauma — caput, scalp abrasions
- gross dysmorphic features — check specifically for features of Trisomy 21 (e.g. flat facies, epicanthic folds, tongue protrusion, brachydactyly with single palmar crease)
- skin
  - dry (post-term)
  - papular lesions post-birth — common and innocuous
  - haemangiomas
  - 'Mongolian blue spot' over sacrum with spina bifida
- breast enlargement — innocuous

Head-to-toe examination

Check:

- head — shape; ask for circumference and plot on percentile chart

- fontanelles — present, not tense; anterior diamond and posterior triangular shape
- face — features symmetrical
- palate — for defects (cleft)
- neck — for lesions (e.g. cysts)
- abdomen — liver easily palpable; tippable spleen is normal; otherwise, same basic procedure as in an adult
- external genitalia (male) — testicles usually but not always palpable
- anus — should be perforate (ask about passage of stool)
- hips — stable, not dislocated or able to be dislocated (this is an essential part of the examination)
- all limbs and digits — specifically check hands and feet for a simian crease, short inward curved little finger (Trisomy 21)
- heart sounds/murmurs/rate (normal newborn = ~140/min)
- bilateral breath sounds.

Neurological assessment

Limb or facial paresis should be obvious by now. Check:

- tone
  - normal to have limbs flexed at rest and when held
  - floppiness raises suspicions of Trisomy 21
- normal reflexes
  - grasping
  - rooting
  - upgoing plantar response
  - 'reflex' walking
  - startle (Moro) — warn parent beforehand!

The absence of reflexes or persistence of reflexes beyond a few months and/or abnormal tone are all indications of CNS pathology.

Paediatrics

Examining children takes practice. Gaining the confidence of the parent and child requires you to not give the impression of being rushed, uncomfortable or overly concerned. For older children, it is possible to interact mostly with the child. The younger the child, the more interaction will be required with the parent as well.

There is no substitute for practice, so examine children until it becomes routine. In younger children and babies in particular, there is a risk that they can become distressed and unsettled without warning. If you are presented with a baby or small child who is sleeping, go for the money up-front by examining the component where a crying, uncooperative child is likely to make the examination difficult. For example, you may choose first to listen to the posterior chest and then anterior for a respiratory or cardiac examination, rather than starting from the peripheries in the 'usual' approach for an adult.

If you do choose to use toys to placate/distract children, choose wisely. Make sure they are child-safe and do not cause noise that will make your examination more difficult. Even if the child does not squeeze the toy, the parent might if the child seems to like the sound! Unless toys are washable and you have time to get them back, you should anticipate making them a gift. In normal practice you have time to get them back. Don't count on it in the exam: have spares.

Although most of the conditions found in adults can also be found in children, some are quite different. Children are more likely to have congenital conditions and 'syndromes' with particular patterns of signs. It is not important that you know all of these, apart from the more common ones such as Trisomy 21. Time spent inspecting

the child from a distance is time well spent. Obvious dysmorphic features, scars, respiratory rate, skin colour, activity and size are all important. Ensure that you have an examination approach for examining children of all ages. In more ways than not, this will be analogous to the systematic examination of an adult. *Examination Paediatrics* (by W Harris, Elsevier, Sydney) is an invaluable resource for assisting you to develop thorough, age-appropriate approaches. Recall that a sign of any chronic disorder in children, including respiratory and cardiac failure, is failure to thrive.

Ask to plot the child's height and weight against percentile charts, including previous values if known. In most cases you will be given this information, although it is not unreasonable for the examiners to ask you how you think the child appears for their age. Make sure that you know the age-appropriate normal weight by whichever formula works for you (e.g. 9 + (age × 2) kg). Become familiar with estimating weights by guessing the weights of children in ED or on the wards (or family and friends) and then checking their actual weights. Knowing how old a child should be when they reach your mid-thigh, hip and shoulder assists estimates of height.

For younger children in particular, you may be asked to assess developmental status. Knowledge of normal verbal and motor milestones is essential (see Table 6.8), while noting there is a large variation in normal: you should not be overly focused on a single milestone if the others appear to be normal.

When discussing the possible diagnosis or differential diagnosis in children, ensure your responses are age-specific. For example, cardiac murmurs in children may be pulmonary flow murmurs or due to congenital heart disease. Disorders such as aortic dissection are exceedingly uncommon. Respiratory conditions such as cystic fibrosis are frequent (especially in exams). Abdominal organomegaly may be from storage disorders and not alcohol excess. Organ transplants are common, so make sure you look for scars if there are peripheral signs of disease (e.g. clubbing) but a relative lack or absence of central signs. The 'cause' may have been removed and replaced with a normal heart and/or lung!

TABLE 6.8 Normal developmental milestones to age 3

Age	Milestone	Terminology
4 weeks	Fixes and follows through 180 degrees	Neonate — up to 28 days
6 weeks	Smiles	Infant — 28 days to 1 year
2 months	Holds head erect when held upright	
3 months	Head turns to sound	
4 months	Rolls over from front to back	
5 months	Reaches and holds with one hand	
6 months	Transfers between hands	
7 months	Sits	
9 months	Crawls; stands with support	
12 months	Speaks single words	Toddler — 1 to 3 years
13 months	Walks	
15 months	Holds cup and drinks	
18 months	Builds tower of 3 cubes	
2 years	Speaks 2–3-word sentences	
3 years	Can use fork and spoon	Preschooler — 3 to 5 years

Time spent in paediatric outpatient clinics or rooms should give you experience of most of the conditions likely to appear in the examination and how to examine them. It will also give you the opportunity to observe the experts interacting with children and assist in developing your own techniques.

Table 6.9, while not exhaustive, lists some of the conditions you should be familiar with. Similar to the adult cases, paediatric patients may commonly be introduced as having a symptom or sign (e.g. difficulty breathing or walking) that warrants examination to facilitate reaching a likely diagnosis or differential diagnosis. Alternatively, you may be asked to examine a specific system (e.g. cardiovascular) or body region (e.g. a joint or whole limb).

TABLE 6.9 Paediatric short cases

Congenital heart disease	Jaundice
The dysmorphic and syndromic child (e.g. Trisomy 21, Turner's syndrome)	Chronic liver disease
Neurologic disorders (e.g. cerebral palsy, spina bifida, neurofibromatosis, hydrocephalus)	Failure to thrive
Neuromuscular disorders (e.g. Duchenne muscular dystrophy, scoliosis)	Obesity
Developmental assessment	Oedema
Metabolic disorders (e.g. cystic fibrosis, diabetes mellitus)	Haemophilia
	Limping or specific joint examination
	Rashes (e.g. seborrhoeic dermatitis, eczema, psoriasis)
	Acute disorders (if child is well enough) (e.g. asthma, bronchiolitis, Kawasaki disorder)

Key points

- Take opportunities each day at work to practise your short case technique.
- Spend time with other disciplines' trainees doing short cases together.
- Commence practice early. It is unwise to leave preparation for the short cases until after the written exam.
- Prepare an examination 'kit' for the exam, be familiar with using everything in it and be able to find it easily during the exam.
- Be prepared for and attempt to pre-empt likely questions during your presentation to the examiners.

Chapter 7

The structured clinical examination

> Success depends a lot upon attention to detail.
> *Joseph Lister*

The structured clinical examination (SCE) is the final section of the examination. Brief encounters with six different pairs of examiners test multiple aspects of candidates' diagnostic, management and communication abilities.

Purpose

The SCE demonstrates candidates' ability to problem solve and 'think on their feet'. As with every other part of the examination, you will be expected to demonstrate the capacity to be a FACEM, not a registrar. You must remain calm, handle any situation with an approach that encompasses what is common and what is commonly deadly, consult where appropriate and arrange safe disposition.

Format

Six stations are completed sequentially over one hour (10 minutes per station). For each station, there is three minutes to get to the station and for reading time sitting outside the examination room, followed by seven minutes with two examiners. During the reading time candidates are provided with written material, a 'prompt' of some sort, to read, but no writing is allowed. The first question may also be provided with this written material. During the time with the examiners, one will lead while the other scribes on a preformatted sheet. After seven minutes, you will be directed to sit outside the next room where the reading material for that station will be ready.

SCEs are usually conducted in an outpatient area or similar facility that has been used the previous day for the long and short cases. Sets of six stations are arranged together, with candidates moving around in a circular fashion like a game of musical chairs. Because the same questions are used for all candidates, those presenting early are isolated until the last group begins. Check your timetable and be prepared to wait if you are in the first groups.

The SCE topics may cover the entire curriculum. You should anticipate at least one paediatric, one medical (including poison/toxins) and one surgical (including trauma) topic. You should also expect at least one skill/equipment station and one administrative scenario. Since 2007 there has been a communication station, with actors playing various roles. Each station has a number of sections the examiners will work through. It is therefore likely that these sections will be presented in combination

(e.g. paediatric resuscitation from poisoning while managing distressed parents and considering non-accidental injury). Anything is possible, including being asked to demonstrate use of equipment and/or a skill. If it can happen at work and be assessed in seven minutes, it can be in the SCE!

The reading material provided will be relevant to the case at hand, but this does not mean that the case cannot take a sudden turn in a different direction. Again, this is the way it is in the world of emergency medicine.

Preparation

The SCE is relatively easy to prepare for. However, the scope of material that can be used in the exam is enormous. Our suggestion is to practise SCEs from each area of the curriculum, paying particular attention to what is common and what is commonly deadly. Administrative issues and communication feature in many SCEs. Be aware of this when preparing for the SCE. To become familiar with the format, talk to examiners, your DEMT and anyone who has done the exam and read the past papers on the College website. Worked examples for each major area are presented at the end of this chapter, while Table 7.1 outlines a list of key topics to prepare for. Although this list is long, it is not exhaustive. Note that 'communication' SCEs may involve junior or senior staff, administration, VIPs, other colleagues and/or relatives. All of the 'administration' topics are also well suited to testing communication.

When preparing with other candidates, take delight in the experience if you manage to prepare a SCE that exposes an area of the curriculum they have not covered. If you are on the 'receiving end' of this experience of being 'caught out' in a practice SCE you have the opportunity to think about how you will handle that situation in the future. If the same situation comes up in the actual SCE (or in real life), there will be a little voice recorder playing in your head from your practice debrief during which you decided the best (or better) way to address the issue.

TABLE 7.1 Potential SCE topics

Subject	Topics	Subject	Topics
Medical	Cardiac arrest Dysrhythmias AMI management Chest pain assessment PE/DVT work-up CCF COAD Severe asthma Allergy/anaphylaxis Gastrointestinal bleeding Meningitis Seizures, including status Headache Acute stroke Acute psychosis Mental health emergencies Acute ophthalmology Pregnancy complications Childbirth Snake/spider bites Toxicology/poisoning Sedation for procedures	**Paediatrics**	Resuscitation • drug doses • equipment size Drowning Fever Gastroenteritis and dehydration Asthma Rash Croup/epiglottitis Limp and acute joint pain Foreign bodies — ear/nose/inhaled/ingested Analgesia/procedural sedation Ingestions of potentially toxic substances Immunisations Consent • mature minor • parents unavailable Non-accidental injury

TABLE 7.1 Potential SCE topics (Continued)

Subject	Topics	Subject	Topics
Surgical/ trauma	Abdominal pain Epistaxis Foreign bodies Wound management Multi-trauma resuscitation, with and without a trauma team available Special trauma situations • head injury (including secondary injury prevention) • neurological complications (shoulder or elbow dislocation) • vascular compromise (supracondylar elbow) • compartment syndrome • pregnant patient • thoracotomy indications Topical/controversial areas • abdominal trauma assessment • clotting factors — factor VII/FFP • spinal injuries/ clearance	**Communication**	Breaking bad news Obtaining consent/ explaining procedure (avoiding medical jargon) Complaints Handover Notification/investigation of adverse events (open disclosure) Distressed/difficult patient/ relative/colleague Underperforming doctor (junior/senior) Harassment/inappropriate behaviour Telephone discussion with referral/referring hospital Emergency procedures (all the codes) Internal/external disaster (activation and response) Counselling potential/ doubtful trainees Dealing with the media Interaction with ambulance/police/fire services Child/elder/spousal abuse
Administration	Impaired practitioner Complaints/adverse events Harassment/ inappropriate behaviour Consent Declining treatment — including religious beliefs (e.g. Jehovah's Witness) Withholding treatment — futile/advance health directives Not for resuscitation orders and disagreements Involuntary detention/ Mental Health Act Child/elder/spousal abuse Deaths in ED/coronial issues Transfer/retrieval	**Equipment**	Oxylog set-up Bag-valve-mask devices — adult, paediatric, neonatal Defibrillators • defibrillation (including paediatric) • synchronisation for cardioversion • external pacing Monitor set-up Infusion pumps Intercostal catheter/ underwater seal drainage set-up Invasive pressure transducers Pulse oximetry Orthopaedic splintage devices (e.g. Donway or Thomas splints)

(Continues)

TABLE 7.1 Potential SCE topics (Continued)

Subject	Topics	Subject	Topics
Administration	Department management • access block • internal/external disaster • CBR/pandemic infections • rosters/fatigue • key performance indicators • staff recruitment/ retention • teaching and training • forensic issues ED redevelopment/ design Interdepartmental conflict	**Skills**	Difficult airway drill Surgical airway Intraosseus access Intercostal catheter/needle thoracostomy Central venous catheter insertion Removal of foreign bodies • nose/ear of child • fish hooks ACLS/APLS algorithms

On the day

By now you will have become familiar with getting to the venue on time and settling yourself down. The hour of the exam will go quickly once you get in to it. Introductions will be brief. Usually you will be asked whether you have read and understood the scenario. This also serves to let you know which of the examiners is going to lead and which is scribing. From this point on anything is possible, so be prepared for sudden changes in direction — not surprised or alarmed. A good FACEM handles stress well and is never fazed! Some SCEs will involve actors or equipment. Deal with these as you would at work.

Preparation time

Outside each exam room you will receive an introduction of some type. Typically this will be a brief description of a situation, possibly accompanied by clinical signs, observations, laboratory results, a photo, an X-ray, an ECG and so on. The first question may also be included. You have three minutes to change stations and read this material. Leave the prompt where you found it: a copy will be available in the examination room.

Use the three minutes wisely. If some observations or results are missing, consider the possibilities. In some scenarios, a differential diagnosis may be clear. Consider what questions might be asked. For paediatric cases, estimate weight and doses of likely drugs and consider non-accidental injury.

The SCE itself

You have seven minutes with the examiners from the time the bell rings. Questions may be predictable to test your knowledge in a specific area or may be designed to test your ability to adapt to sudden developments — for example, an unexpected arrest, a demanding relative, you notice the patient is the CEO . . .

One examiner will ask the questions while the other takes notes on a preformatted sheet prepared at the pre-examination meeting. The examiners typically 'test' the SCE on a fellow examiner or other FACEMs at the pre-examination meeting to ensure that the questions run smoothly and in the time available. There is no rush.

Sit comfortably: do not fidget. Answer questions directly and if you do not know an answer, say so. If time permits, the examiners may return to a section where you had a 'mental blank'. Do not waffle or follow your own agenda: answer the question asked,

not what you want it to be. One approach is to begin with a (very) brief synopsis and then expand on the possibilities. If the examiners interrupt you or redirect you along a certain course, comply and do not be concerned —you may already have answered the questions they have to follow and now they want to give you the chance to earn bonus points!

There are no tricks or hidden agendas in the SCE. You may be prompted in certain directions or asked to repeat, reconsider or expand on an answer if the examiners feel you may be able to answer more fully. If you have committed a 'fatal error', the examiners will go back over the issue and give you every opportunity to realise your mistake and correct it. It is okay to change your response if you realise that you have made an error or to point out a particular differential diagnosis that you should have given earlier but, for some reason, overlooked.

The interval between stations

When the bell rings, it is time to move on, physically and mentally. Each station is marked independently. The next pair of examiners does not know whether you have just gunned or bombed. Focus on the task at hand and prepare for the next 'patient'.

Sample SCEs

The following are some worked examples of the types of scenarios that may be encountered in the SCE. One example is given for each major category along with a mix of other issues. This framework could be used to develop your own practice scenarios. There is usually no shortage of colleagues eager to take part in communication role-playing!

SCE 1: administration

As director of a large suburban Emergency Department, you have been asked by medical administration to respond to a letter of complaint, an excerpt of which appears below:

> My daughter had hours and hours of terrible abdominal pain, but despite my repeated requests, the doctor we saw in the Emergency Department showed no interest in helping her. The doctor looked drowsy and said she was very tired from her heavy workload. She said that my daughter wasn't really sick and that it was just period pain, and so she sent us home.
>
> The next day, after my daughter's appendix burst and we rushed back to the Emergency Department, the surgeon told me that my daughter had all the typical signs of appendicitis and should have never been sent home in the first place. He said her appendix would never have burst if the doctor had done her job properly when we came into Casualty.

Question 1: How would you deal with this letter of complaint? (2 minutes)		
Expected response	**Details and comments**	**Pass criteria**
Acknowledgment (verbal and/or written)	Medical administration Complainant	
Investigation	Medical records Staff involved (medical and nursing) Complainant Check daughter not adult *(If candidate asks, daughter is 14 years old)*	
Response	Timely (< 72 hours ideally) Non-judgemental Apologise sincerely/honestly without admission of liability Verbal better/written if unable	No denial if apology appropriate
Counsel staff Medical defence as appropriate		
Audit/quality	Review ED processes, change as indicated Use as educational exercise Arrange for someone to speak to surgeon about criticising colleagues	System review
Keep records of complaints		

Question 2: The patient and her mother wish to speak to the registrar concerned. Would you agree to this and, if so, under what circumstances? (2 minutes)		
Expected response	**Details and comments**	**Pass criteria**
Specifics of complaint	Appropriate in most cases Helps successful resolution	Pros and cons
Environment	Quiet, uninterrupted area Adequate time set aside Preferably neutral informal environment *(Prompt candidate for environment if not given)*	Appropriate environment
Doctor concerned	Fully informed pre-meeting Apology honest, sincere Senior staff present +/– mentor Medical defence aware/give consent as appropriate	Involve administration
Hospital	Medical administration aware/give consent	

Question 3: You discuss this complaint with the registrar involved. She promptly bursts into tears and admits to having used pethidine for most of the year. She has become increasingly depressed about her inability to cope. What will you do now? (2 minutes)

Expected response	Details and comments	Pass criteria
Complaint-related	Not appropriate for registrar to meet with complainant Manage complaint without this meeting	Prompt to address
Workplace issues	Will need time off — needs sick leave certificate Arrange cover for shifts Maintain confidentiality	
Medical issues	Offer to arrange screening for HIV, Hep B, C etc. Offer medical and drug support services re management/rehabilitation etc.	
Psychiatric issues	Requires urgent objective assessment and management of depression and potential for self-harm May need admission to a psychiatric/drugs of dependency facility Explore psychosocial supports — family/partner/friends etc.	Appropriate psychological care and follow-up
Legal issues	Must be reported to Medical Board Inform medical administration Maintain confidentiality within the hospital	Appropriate reporting
Other	Make aware of AMA/impaired practitioner service; supervised and well-monitored clinical practice; provision of mentors	

Question 4: When would you be happy for this registrar to return to work in ED? (1 minute)

Expected response	Details and comments	Pass criteria
Medical	Appropriate drug-free interval, with ongoing drug screening and dependence help Mentor available	
Psychiatric	Ongoing support and monitoring	
Medicolegal	Negotiate with medical administration and medical board regarding restrictions (e.g. cannot write S8 prescriptions)	

SCE 2: medical

A 29-year-old ambulance officer presents after 24 hours of vomiting. He looks sweaty and unwell. His initial observations are as follows:

- T 37.3°C
- PR 90/min
- BP 80/50 mmHg
- RR 22/min
- SaO_2 99% (room air).

Question 1: How would you assess this man?		**(2 minutes)**
Expected response	**Details and comments**	**Pass criteria**
History — presenting complaint/systems review	Symptoms: fever, abdominal pain, change in bowel habit, dysuria, frequency, cough, sputum, fluid intake, postural symptoms, headache	History features
Past history	Any previous episodes similar Other medical conditions: particularly immunosuppressive *(Prompt candidate: any predisposing factors?)*	
Social	Alcohol, medications, drugs Contacts with similar (home/work) Travel	Medication and contacts history
Examination	For cause — all systems potentially relevant	
Investigations	Bedside: BSL, urinalysis, ECG Lab: full blood profile (infection), U&Es (renal function, Na, K), Ca, LFT if indicated on history or examination Cultures: urine, blood Radiology: chest X-ray	BSL, ECG, basic labs

Question 2: How will you manage him?		**(2 minutes)**
Expected response	**Details and comments**	**Pass criteria**
Triage	Australasian Triage Scale (ATS) 2 Resuscitation area, team approach	
Resuscitation	ABC — needs O_2, IV fluids and monitor response, non-invasive monitoring	Basic description of ABC approach
Specific treatment	Depends on what is found, e.g. goal-directed therapy and antibiotics for severe sepsis	
Disposition	Depends on findings and response	

Question 3: Here are the lab results [to be handed over]. Please interpret them. **(2 minutes)**

Hb	**154**	**Na**	**130**	**Urea**	**10.7**	**Gluc**	**4.1**
WCC	**13.3**	**K**	**5.2**	**Creat**	**94**	**pH(v)**	**7.25**
Platelets	**239**	**Cl**	**101**	**Ca**	**2.39**	**CO_2(v)**	**30**
		HCO_3	**21**	**Alb**	**48**		

Expected response	**Details and comments**	**Pass criteria**
	Hyperkalaemia Hyponatraemia Metabolic acidosis with normal anion gap (AG) *(Prompt candidate re AG if needed)* BSL normal	Normal AG metabolic acidosis
Differential diagnosis	Hypoaldosteronism Diarrhoea Drugs (e.g. acetazolamide, ACE inhibitors, K^+ sparing diuretics)	Hypoaldosteronism plus two other *(Prompt for causes of hyponatraemia)*

Expected response	Details and comments	Pass criteria
Differential diagnosis	Renal tubular acidosis *(Prompt candidate if needed)*	
Further investigations	May consider arterial blood gases Random cortisol once consider differential diagnosis	

Question 4: You consider hypoaldosteronism as a likely cause. What are the differences between the available steroids? (1 minute)

Expected response	Details and comments	Pass criteria
	Hydrocortisone: glucocorticoid and mineralocorticoid action; can still do a short synacthen test Fludrocortisone: both properties but greater mineralocorticoid action Dexamethasone and prednisone: glucocorticoid	

SCE 3: surgical/trauma

You are the consultant on call in a rural hospital on a Thursday evening. You receive a call from your registrar who has just been notified that ambulance officers are bringing in an unconscious woman who was involved in a head-on collision with a truck on the highway. Her current observations are:

- GCS 5 (E1, M2, V2)
- PR 110/min
- BP 105/70 mmHg.

She has a large frontal laceration, partially obstructed breathing and SaO_2 92% on high-flow O_2. A Guedel airway could not be inserted. The registrar is an advanced trainee and there is also one RMO on duty. You will probably arrive at ED a few minutes after the patient.

Question 1: How would you respond to this call? (2 minutes)

Expected response	Details and comments	Pass criteria
Immediately come in		Come in
Prepare department	ED staff — current ED nursing, medical, auxiliary staff; other help as available for this patient and rest of department; activate a trauma call if hospital policy Other staff — surgical team, lab and X-ray *(If asked, inform candidate that a lab and radiology with CT capability are on-site)* Prepare the resuscitation bay including airway equipment, drugs, warmed fluids, O negative blood	Consider all aspects
Obtain more information if possible	ED staff Ambulance	

Question 2: You arrive to find the registrar has successfully intubated the patient, who is now beginning to move with extensor posturing of the right leg and arm and coughing on the ETT. She appears to be pregnant. The secondary survey findings are:

- **a laceration of the left upper eyelid and a dilated pupil unresponsive to light**
- **a closed fracture of the left clavicle**
- **the abdomen is consistent with a gravid uterus at the level of the umbilicus.**

Outline your actions from this point. (2 minutes)

Expected response	Details and comments	Pass criteria
EMST/ATLS directed resuscitation	A — confirm ETT placement and that a cervical collar is present B — confirm adequate ventilation bilaterally C — ensure 2 × large bore IV cannulae, administer fluids, assess peripheral pulses and perfusion. Consider wedging to the left while maintaining spinal alignment (pregnant) *(When asked, tell candidate she is well perfused)* D — clarify GCS pre-intubation, assess other pupil *(other pupil is normal — local trauma to left orbit)*, reflexes, plantar responses, BSL *(if/when asked BSL 2 — should treat as soon as known and keep monitoring)* E — need to examine back/perineum Keep warm once examined	Adequate address to life threats Orderly approach
Rapid neurological assessment and decision to allow to wake or paralyse/sedate	Cannot leave biting on tube Extensor posturing is an ominous sign; together with the pupil dilatation it suggests imminent coning — traumatic mydriasis of left pupil is a possibility, but should not dissuade against instituting aggressive treatment for raised intracranial pressure Should maintain ETT with sedation/paralysis *(Prompt candidate to address if not mentioned)*	Pros and cons
Recheck vital signs after immediate management including BSL (if not done already)	*As above*	BSL earlier or now
Secondary survey	Neurology — as much as possible prior to paralysing Secondary survey with full head-to-toe examination when able Assessment of pregnancy will be needed but not an immediate priority; likely 20-week gestation based on fundal height and thus no role for emergency delivery	Pregnancy acknowledged Gestational age assessment reasonable
Ancillary	Orogastric tube Urinary catheter	

Question 3: A secondary survey reveals no other injuries. The patient remains haemodynamically stable: pulse 90–100, systolic BP 100–110. How would you investigate this patient further? (2 minutes)

Expected response	Details and comments	Pass criteria
Chest X-ray	Shield abdomen Ensure tubes correctly placed Look for other thoracic abnormalities	Trauma series
Lateral C-spine X-ray	*(If asked, plain films show anterior crush # C4)*	
Pelvis X-ray	Can discuss pros and cons	
ECG	Can discuss pros and cons	
Labs	Full blood profile, U&Es, BSL Group and hold — blood type as minimum (Rhesus status) *ß-HCG (discuss utility if mentioned)*	BSL Rhesus status
CT scan of head and cervical spine	Encircling abdominal shield *(Prompt discussion about how to clear the thoracolumbar spine)*	CT scan of head and cervical spine
Assess pregnancy	Doppler for fetal heart rate initially Ultrasound if available Consider CTG if > 26/40	Who and when
Abdominal assessment	US/CT/DPL/nothing *(Prompt discussion)*	Pros and cons

Question 4: The retrieval team will be able to transport the patient in approximately 90 minutes. What else needs to be done in the interim? (1 minute)

Expected response	Details and comments	Pass criteria
Bed arranged (if not already)	Liaise with ICU, neurosurgery and obstetric teams at accepting hospital	Arrange bed
Packaged for transport	Lines secured Notes copied X-rays — preferably originals — with patient	Package appropriately
Notification of relatives, including prognosis	*(If running well on time, state the patient's identity is currently unknown and ask candidate how they would identify her. Prompt that she has a medic alert bracelet but no wallet)*	Notification
Registrar education	Importance of BSL (missed) Constructive feedback about trauma management How to use medic alert for patient ID	

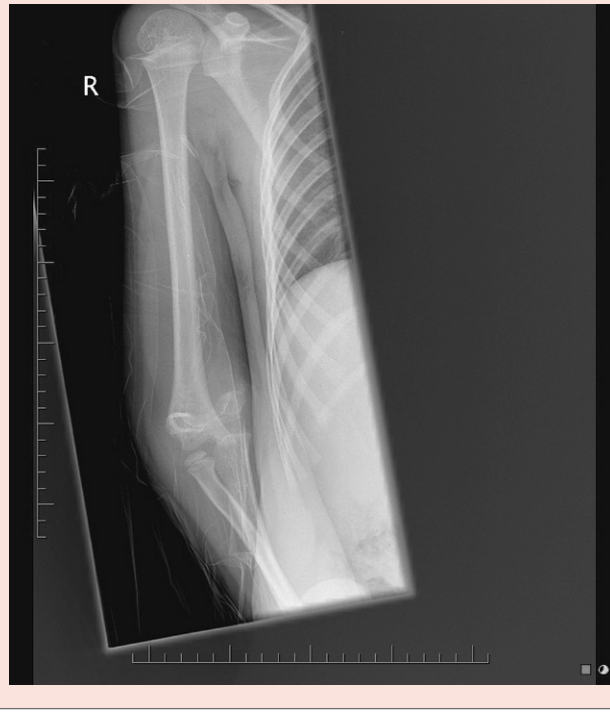
SCE 4: paediatrics

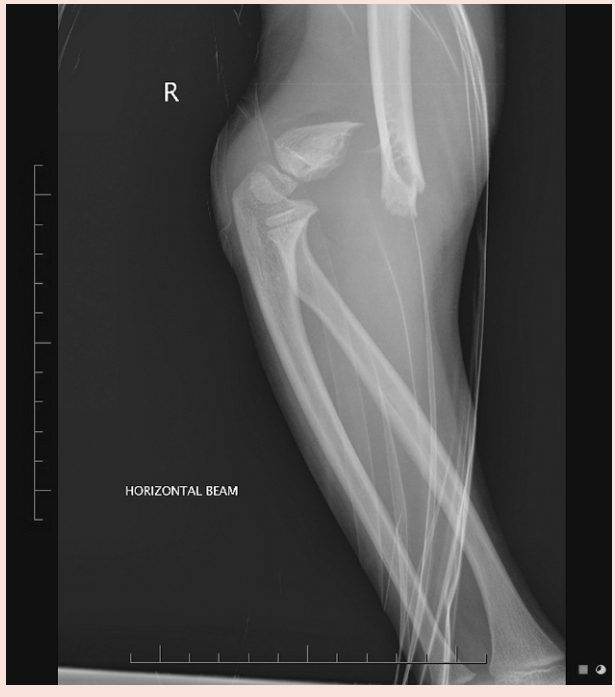
A six-year-old French girl is brought into your Emergency Department by a casual baby-sitter after a fall at home. The child is distressed and will not move her left arm. The left elbow is swollen and tender. The distal pulse and sensation are normal.

Question 1: What is your immediate management? (2 minutes)

Expected response	Details and comments	Pass criteria
Triage	ATS 2/3	
ABC	Exclude immediate life threats and look for other injuries	Basic ABC
Specific	Analgesia — discuss options and ask for correct doses *(Prompt candidate for estimated weight)* Apply sling and ice pack Circulation observations repeated after sling/splint	Appropriate analgesia options Weight estimate reasonable
Disposition	X-ray Orthopaedic consultation Possibility of needing reduction in theatre — issues of consent (need to contact parent/guardian) Consider non-accidental injury (NAI)	X-ray NAI

Question 2: X-rays have been performed [give to candidate]. Please describe them. (1 minute)





A displaced supracondylar fracture should be diagnosed. A posterior fat pad sign is also present (haemarthrosis).

Question 3: On re-examination, the pulse in the arm is now absent. What will you do now? (1 minute)

Expected response	Details and comments	Pass criteria
Remove arm from sling and straighten it	Check whether pulse returns as doing it *(It does not)*	
Expedite orthopaedic review for likely emergent reduction in theatre	Note issues of consent	Urgent orthopaedic review

Question 4: The orthopaedic surgeon arrives and the pulse is still absent. He instructs that the child be taken immediately to theatre. How will you obtain consent for this procedure? (1 minute)

Expected response	Details and comments	Pass criteria
	Surgeon primarily responsible for consent Try all avenues to contact parents Urgent situation (threat to limb) and may need consent from medical administration	Consent options discussed

Question 5: The parents arrive just as the child is being taken to theatre. The father starts conversing angrily with the baby-sitter in French. How will you manage this situation? (2 minutes)

Expected response	Details and comments	Pass criteria
Determine whether father can speak English	If not, will need an interpreter (baby-sitter no longer appropriate as sole interpreter) Awareness of interpreter service essential *(If candidate can speak French, ask them what they would do if it was a language they could not speak)*	Need appropriate communication
Defuse situation	Be mindful of potential NAI on part of baby-sitter or parents	
Address consent issues	Provide information on procedure (may need to come from surgical team)	

SCE 5: equipment/skills

You have just intubated a 75-year-old, 60 kg woman with respiratory failure after a fall in which she sustained a flail chest with pulmonary contusions. Due to circumstances within your hospital, you must arrange for her transfer to another hospital's ICU.

Question 1: Please set up this ventilator [Oxylog 1000] to ventilate this patient and check that it is working correctly. (2 minutes)

Expected response	Details and comments	Pass criteria
Describe	Ventilator identified Circuit with HME and PEEP valve *(Prompt candidate, if necessary)*	Oxylog 1000
Check oxygen source and turn on	Check alarms	
Set	Rate 12–14; MV 5–7 L/min; TV 400–500 mL; FiO_2 no air mix initially PEEP valve set at 5 cmH_2O initially *(Prompt candidate for rate and minute volume, if necessary)*	Appropriate settings
Demonstrate	Working as expected Spirometer use	

Question 2: How would you monitor this patient's respiratory status over the next two hours? (1 minute)

Expected response	Details and comments	Pass criteria
Clinical	Vital signs — pulse, blood pressure Chest examination — expansion and auscultation findings; frequency/character of secretions	
Monitors	ECG; SaO_2; $ETCO_2$	ECG, SaO_2, $ETCO_2$ essential
Other	Alarms — peak pressure, supply failure and disconnect ABG — perform serially to optimise ventilation Chest X-ray — repeat if deterioration occurs	

Question 3: Fifteen minutes later, you are called back to the patient because the SaO_2 has dropped to 70%. Detail the possible causes and your immediate management. (2 minutes)

Expected response	Details and comments	Pass criteria
Possible causes	Probe off (usually obvious) Poor blood flow to probe area O_2 supply failure or disconnection Leaks (circuit, cuff deflation, high peak pressures) ETT problems — endobronchial migration, dislodgement or blockage Disease complications (e.g. pneumothorax, haemothorax, evolving contusions) Ventilator dysynchrony *(Prompt candidate to start from one end and work along)*	At least three of these
Action	Assume it is a real problem Disconnect patient from ventilator and hand ventilate with 100% O_2 Examine patient — ensure trachea midline, chest expansion, air entry and breath sounds Consider suctioning airway Check monitors — SaO_2, $ETCO_2$, airway pressures Check ventilator and O_2 supply before reconnecting to Oxylog May need extra PEEP May need to involve intensivist — reassess fitness to transfer and need for a better ventilator	Remove Oxylog from decision

Question 4: The retrieval service calls to say that it will not be able to collect the patient for another 12 hours. What will you do? (2 minutes)

Expected response	Details and comments	Pass criteria
Consider other transport options	Road/rotary/fixed wing Consider level of escort available and ability to travel by chosen method	Pros and cons
Consider other bed options	Liaise with local intensivist for assistance — may need to admit this patient and transfer out someone more stable Liaise with other nearby hospitals Remain in ED if necessary but negotiate the most appropriate possible staff to care for her	Other options
Other	Continue quality supportive care: • orogastric tube and urinary catheter • fluids • sedation and paralysis • eye, mouth and pressure area care Communicate with relatives Keep in touch with retrieval service and update receiving hospital regularly	Ongoing patient management

SCE 6: communication

You have been managing Amy Jones, a 16-year-old girl who presented alone with PV bleeding. A urine β-HCG is positive and ultrasound shows a viable fetus. Amy has requested that her mother not be told she is pregnant. The nurse has just approached you saying that Amy's mother is demanding to see you immediately. She has been escorted to the relatives' room and is awaiting your arrival.

You will **role-play** a conversation with Mrs Jones, who will be played by an actor. The examiners will not interact with you and will be observing only.

Information for examiners

The actor who will play Amy's mother has been briefed with the following background information:

- You are divorced.
- Your daughter, Amy, was adopted. She moved out of home four months ago to live with her boyfriend.
- Amy has been working at a local supermarket.
- Until Amy moved out, you shared custody of Amy with your ex-husband.

Information for actor playing Amy's mother

When the doctor tells you that Amy is an adult, you will get upset. However, you will calm down and accept the situation if the information is presented to you appropriately.

Question: This is Mrs Jones, the mother of Amy. Please discuss the situation with her.

Expected response	Details and comments	Pass criteria
Introduction	Identify self by name as doctor caring for Amy	Essential
Confirm information known	Clarify what the mother knows and her concerns Use non-confrontational manner Preserve Amy's confidentiality Explain the legal implications of confidentiality as related to minors and adults Clarify the legal status of Amy as a minor or an adult; adult defined from age 16 if living independently or the individual has a child	Reasonable approach expected Establish rapport Active listening picking up non-verbal cues Body language appropriate Language appropriate — not medical jargon
Information released only with consent	Will be classified as adult Information can be passed on only with the consent of the patient	Identify status as adult Protect confidentiality
Resolution of situation	Empathise with mother's position Offer to liaise with Amy with intention of creating direct dialogue between them	Reasonable resolution

Key points

- During the three minutes' preparation time, consider the potential scenarios that may be presented.
- Each question is a new opportunity. Do not become preoccupied with your previous answers: focus on the one at hand.
- Try to relax and have fun — this is your opportunity to show yourself as a respectful but knowledgeable junior colleague to fellow consultants.

Chapter 8

Publication/presentation requirement: regulation 4.10

> Genius is one per cent inspiration, ninety-nine per cent perspiration.
>
> *Thomas Alva Edison*

Candidates must complete the publication/presentation component of advanced training to be eligible to sit the fellowship examination. Although a minority of trainees ruled eligible to sit the fellowship examination prior to 2004 may complete this component *after* sitting the fellowship examination, the component must be satisfied within three years of passing the exam or the pass will become null and void and a resit will be required. For this reason, it is preferable to finalise this component of your training *prior to* embarking on your study program for the fellowship exam. Otherwise, it can distract from your study progress.

Research presented for this component must be relevant to emergency medicine. As such, trainees who have completed projects prior to entering the training program *may* be granted an exemption if their previous work meets the requirements of the College. However, this is uncommon.

It is of utmost importance that you carefully study the requirements of regulation 4.10 regarding authorship, content and procedural matters as set out in the College website.

Purpose

Regulation 4.10 serves a number of purposes. Most FACEMs are involved in research during their careers, whether as investigators or recruiting patients for studies being run by others. This component is designed to give trainees insight into or 'a taste of' how research works. Even for those who are not involved in research later in their careers, it is imperative to be aware of study design and the concepts of evidence-based medicine in order to critically appraise the research of others. Being directly involved in a research project provides valuable insight into the particular challenges of conducting quality research. This is a two-way process, making you more sensitive to the importance of ensuring good study design and also more astute in detecting methodological flaws. Finally, of course, the research thus performed aims to boost the collective knowledge of issues related to emergency medicine and ultimately to improve patient care.

Format

Research undertaken for the 4.10 may be presented in a number of ways:

- publication in a peer-reviewed journal
- an oral presentation at an ACEM-recognised conference judged by ACEM-designated adjudicators
- a poster presentation at an ACEM-recognised conference judged by ACEM-designated adjudicators
- thesis.

Regardless of the mode in which the 4.10 is completed, the path is the same. Therefore, this is not an essential decision in the initial stages. It is more fruitful to concentrate first on what you will do and how you will achieve this than whether you will be submitting for publication or applying for an oral or poster presentation. However, eventually you will need to choose which format best suits the topic and your personal preferences.

Publication

Publication in a refereed journal carries with it the challenges of going through the manuscript acceptance process. Your article will undergo peer review by a number of persons specifically selected for that purpose (usually experts in that particular field). This level of scrutiny can be disheartening depending on how well you handle critique (rarely is a submission accepted without revision), but it is also highly productive as you receive expert suggestions on improving your article. The process can take a considerable period of time depending on the publisher selected, although most have developed rapid turnaround systems.

Your article does not actually have to be published for your 4.10 to be considered satisfied for the purpose of being eligible to sit the fellowship exam. Evidence of acceptance for publication is sufficient, leaving you free to concentrate on preparing for the exam itself while you wait to see your name immortalised in print.

The strength of choosing publication is that you will have this forever on your CV. Should you choose to continue to publish, the lessons you learn from this experience will be invaluable. Subsequent projects will become progressively easier.

Oral presentation

The most popular form chosen is for oral presentation at a recognised meeting — usually a national, state or regional emergency medicine meeting. This popularity probably arises from familiarity, as this is the most common form of presentation at meetings in general and is similar to the way the majority of teaching sessions are run.

However, even though an oral presentation does not require submission to a publisher, you do need to submit your project details to the College for consideration. When assessing your project, the College follows the same basic procedure as the publishing review process.

The oral presentation tests your capacity to speak in a public forum, keep to time and handle questions asked by FACEM adjudicators. Many of these questions will be the same as those posed by the publishing review process, but time constraints will mean the depth of questioning and time for your response will be much less than via the publishing process.

If you are comfortable with public speaking and have prepared and know your project well, you will find an oral presentation far less stressful. The particular advantage is that the decision to accept/reject your proposal will be made in a known time frame without the uncertainty associated with publication time lines.

Poster presentation

Poster presentations are often overlooked as a format, although they have become increasingly popular in recent years and we encourage you to consider this option. Preparation is essentially identical to that for an oral presentation, including material that must be submitted to the College. However, there is a greater capacity to accommodate poster presentations than oral presentations from the point of view of meeting organisers and so a submission to present a poster (or tick the box that says 'either') is more likely to be accepted than a request only to present orally.

Posters do not have to be large, glossy and expensive. Although most posters are professionally printed, it is perfectly acceptable to print out A4 or A3 sheets of paper and arrange them on the posterboard using the standard headings. If you do elect to have your poster printed professionally, allow sufficient time so that proofs can be read and corrected if necessary.

The poster itself will do some of the 'talking' for you, becoming a focal point of discussion. Posters are generally put on display for a period of time prior to the presentation session, providing you with the opportunity to get feedback from those browsing by. Explaining your project and discussing issues with strangers in an informal manner is a reasonably low-stress way of finetuning your presentation prior to the session with the adjudicators. Your time with the adjudicators will be split between you explaining your project and them questioning you on details about it. More information can be found on the College website.

A poster also gives you something to take away once you have been successful. The poster can adorn your office or take pride of place in the department for many years to come.

Thesis

If the research bug is part of your make-up, you may wish to commence more formal study from the outset and have the 4.10 project become part of a wider research endeavour. This will require a nominated supervisor and considerable time in planning the way forward. If this is for you, you are strongly encouraged to meet your local or regional research group, who will be invaluable in assisting you with the 4.10 project and your wider research endeavours.

Preparation

There is no ideal time to do the project; it depends on your professional and personal commitments. We recommend embarking on the 4.10 after being energised from your success at the primary examination and getting what most trainees perceive as an obstacle out of the way after a suitable period of rest and relaxation.

Whether you elect for publication or presentation, the whole project needs to be planned well ahead of time. The College has nominated 4.10 mentors in every region whose names are readily available. These people all have significant experience in research and have supervised many 4.10 projects. Make contact with these individuals as early as possible. They will be invaluable in all aspects of planning and conducting your study.

In addition, time spent carefully considering all of the following *before* you begin is essential.

Individual or team

Decide from the outset whether you work better by yourself or with one or more colleagues. If there are a number of you at the same stage of training, you may wish to work collaboratively on several projects, with one of you acting as lead investigator (and author) for each project. Sharing the workload and addressing the issues that arise

as a group can be helpful. If you do work with others, however, choose very carefully: you want to work with people who are experienced and compatible and who will pull their weight.

Selecting the topic

Probably the hardest decision you will have to make is what your research topic will be. Sometimes a rush of enthusiasm based on the fortuitous discovery of an interesting research question or dilemma triggers your thinking. However, most trainees need time to select their topic.

Coming up with a great idea will be less of a stumbling block if you have an enquiring bent towards clinical medicine. Why do we choose a particular investigation or way of managing a patient? Is there a better way of doing a procedure? Can we better predict which patients will present or benefit most? These are questions that need to be posed frequently for you to become a more informed evidence-based clinician. Constant enquiry helps in 'currency' of knowledge and, in this instance, allows you to formulate worthwhile research questions of clinical relevance and importance to emergency medicine practice.

A research question that captures and maintains your enthusiasm and interest is the start to the 4.10 'journey'. This may occur from acute personal observation in your clinical life, attendance at critical appraisal forums, reading the medical literature widely or talking to your peers or consultants about their research interests.

Being forced to think up a project as a deadline looms may be counterproductive if you have not been involved in research previously. This strategic phase of looking out for, formulating and then designing a feasible and useful study may take some time. A 'shopping' type approach in looking around to buy the most attractive product is recommended, rather than thoughtlessly committing to the first project offered to you for which you do not feel a deep attachment.

When deciding on a topic, there are three things to bear in mind:

- First, you need to ensure that the question you are asking is **clear**. If your question is not specific and achievable, your answer will not be either. As a general guide, if you are unable to state the aim of your project in one sentence, you are likely to struggle.
- Second, your project must be **achievable**. Select a topic that can be addressed with the resources you have in a time frame that is not excessive. Resist the temptation to broaden the topic as more ideas come to mind, as this will only create more work for you.
- Finally, you need to consider the **relevance** of your research topic. The usual way of assessing this is the 'so what?' test. Ask yourself whether the result of your study has relevance to clinical practice. If the answer generates a response of 'so what', then you should seriously reconsider your project. If your project involves enrolling subjects (patients or staff), it is more likely to be approved by ethics committees or other regulatory bodies if there is a direct benefit anticipated. If funding is required, the project's relevance will be even more important in order to convince fund-holders to commit to it. We strongly recommend you choose a topic that is relevant and worthwhile. This also makes it more enjoyable!

Once you have selected a topic, conduct a literature review to ensure that the answer to your question is not already available. A well-conducted literature review (see Chapter 9) may also provide other research ideas, suggest ways of streamlining your project and give valuable insight into the particular design that will best suit the topic. Because of the time frame involved from start to finish, you should repeat the literature review prior to final presentation, in order to ensure that other relevant information has not come to light during this interval.

Study design

Chapter 9 will provide useful suggestions on different types of study designs. It is unlikely that your first research project will be a multi-centre, randomised controlled trial assessing a major health issue. You will need to develop a balance between higher levels of evidence, which require higher levels of expertise and time, and lower levels of evidence where simpler designs are appropriate.

As a general guide, studies that enrol patients for intervention or observation prospectively are viewed more favourably. However, they can be the most difficult to implement successfully, as proposals must be approved first by ethics committees, medications or interventions may need to be specially prepared in order to ensure adequate blinding and projects that involve follow-up will always involve a percentage of subjects that will be 'lost'.

Non-randomised studies are definitely inferior for assessing the effect of a medical intervention. Prospective observational studies are useful to detect adverse effects of treatment or to follow the natural history of a disease. On the good news side, non-intervention and non-prospective studies are an appropriate and valid trial design for most other purposes. Although such designs are often mistakenly adjudged to be inferior to the randomised controlled trial, non-randomised designs using easily collected or existing data such as that from cross-sectional surveys, clinical notes, ED patient clinical databases (EDIS, for example), registry information (major trauma registries), mission reports (aero medical service providers) and procedural databases are a valid, and often the only, way to answer non-intervention questions.

For instance, trauma epidemiology is best examined using trauma registries. Case-control studies are used to determine the role of detrimental lifestyle factors such as smoking in disease causation. Case series may offer speculative evidence of new side effects of a treatment. Observational series can assess the effects of interventions that it would be unethical to deny to a treatment arm in a randomised trial (e.g. evacuation of an EDH). The critical element in study design is that the study type chosen is valid for, and best suited to, the research question.

The design and conduct of a study is similar to critically appraising a research paper, but done in reverse (for more detail, see Chapter 9). A study needs to be methodologically internally valid before even considering its generalisabilty or applicability. Time taken in meticulous study design is well worth it, as mistakes in design are not easily rectified during the study and may invalidate the study results.

Write your study hypothesis and methods *before* you commence the study. Ensure that the aim of the study is clear and will be addressed by the methods chosen. The typical headings to consider when writing the protocol for your randomised interventional study are provided in Table 8.1. These can also be applied to other study types, although some sections (e.g. interventions) may not be required or be appropriate. These items also form the basis of submissions to ethics and regulatory bodies. Time spent considering each of these items and how they apply to your project will make such submissions and your subsequent project write-up much easier.

A well-constructed project is virtually 'written' before the data are collected. Only the discussion then needs to be written once the results are collated.

Statistical analysis

Issues regarding sample size, comparison between groups and specific method(s) to analyse difference will vary depending on the topic chosen and study methodology. Some of these issues are addressed in more detail in Chapter 9. Expert statistical advice is required early in your project to ensure that each method chosen is appropriate and your project is achievable.

TABLE 8.1 A template for a randomised controlled trial protocol

Summary
Introduction
- *background and research rationale*

Overview of the trial design (e.g. multiple arm trial, crossover design)
The research question
- *aim and objectives*

Trial population
- *trial site(s) and population(s)*
- *inclusion and exclusion criteria*
- *sources or methods of recruitment*
- *information for participants*

Allocation of interventions
- *methods for randomisation and stratification*
- *methods for concealment of allocation*

The interventions
- *description of intervention and intervention delivery*

Outcome assessment
- *outcome measures*
- *timing of outcome assessment*
- *blinding*

Post-recruitment retention strategies
- *participant retention*

Safety monitoring and adverse events
- *data and safety monitoring*
- *adverse event reporting requirements*

Data collection and management
- *data collection*
- *data management system*
- *data entry*
- *quality control*
- *progress reports*
- *final reports*

Sample size
- *sample size justification*
- *compliance and missing data*

Analysis strategies
- *results tables and figures*
- *statistical analysis*
- *interim analyses*

Ethical aspects
- *approval process*
- *participant consent*

Trial management
- *registering the trial*
- *trial management*
- *local coordination*
- *research governance and good clinical practice*

Economic evaluation
Consumer involvement
Reporting, dissemination and notification of results
- *publication policy*
- *disseminating the results*

Conflicts of interest
References

Source: adapted from www.practihc.org/toolindex.htm.

Time required

When you have found a research question that is appealing, you need to determine whether it can be answered within your time, resource and expertise limitations.

The first step is to determine the true incidence of the condition or study group you have chosen. Although one or two examples of a particular condition may have prompted your interest in a topic, the true incidence may be substantially lower in everyday practice. You are strongly encouraged to use available databases (such as EDIS or registry data) to further determine the frequency of presentations. This result can then be matched to the power calculations the statistician has helped you determine and a likely time frame for data collection can be estimated.

Be aware that estimates of likely subject numbers are generally well in excess of actual suitable subjects. As a rough guide, we suggest you assume that no more than one in four eligible 'patients' or subjects will actually be recruited successfully. For most studies, including those where data are collected from medical records, we suggest you undertake a 'pilot' study before commencing the main study. This will help clarify whether your assumptions have been correct regarding numbers, as well as provide insight as to the feasibility of collecting the data you require. A well-conducted pilot study may enable you to make small changes that will greatly improve the efficiency of your overall project.

Approval

Studies involving patients require approval or waiver from the local ethics committee. Projects that do not involve changes to patient care (such as analysing the outcomes from a newly introduced medication) will probably be waived by the ethics committee if conducted as a quality assurance project. However, the same standards of data integrity and confidentiality will still apply.

Where patient treatment changes are involved, patient consent will almost certainly be required. Having a project that is intended to improve the outcome for all patients will prove more successful for gaining ethics committee approval and patient recruitment.

Collecting data

Undertaking a pilot study is also an excellent way to iron out any 'bugs' in your data collection form or methodology, and we strongly recommend that you carry out such a study before continuing with the main body of your project.

Data can be collected by you (and your colleagues, if working as a group) or by others. If the study is designed to be blinded and an observer is required, you may have to enlist assistance to prevent invalidating data collection. If data collection involves colleagues recruiting subjects and/or completing forms, your persuasive powers will be put to the test. Keeping them 'sweet' by providing constant positive feedback is essential to maintaining enthusiasm and ensuring that your project does not flag. We have also found that chocolate is an excellent currency! Detailed education sessions with each new resident rotation, visits to the recruiting sites, reward systems for good patient recruitment and other measures to keep recruiting staff enthusiastic are crucial for the study to meet its due schedule. The data acquisition period in a prospective or intervention study often takes a relatively long time, so it is important to think about strictures or hindrances to participant recruitment. Be inventive to keep recruitment going.

It is also important to enter the data collected as they become available in a well-organised and secure de-identified database. The construction of dummy tables to trial data entry and pre-study consultation with a clinical trials methodologist or statistician are crucial to ensuring that only data relevant to the study objectives are collected. Study analysis plans should be carefully formulated in conjunction with a statistician and pre-specified in detail during the write-up of the study protocol. This ensures that appropriate outcome data are obtained and then analysed reliably. When the study is closed, with no further data entry permitted, it is crucial that you consult with a statistician to make the correct unadjusted and adjusted interpretations of the data.

The write-up

The writing-up phase for submission to a journal or presentation at a conference is often the most enjoyable phase, as you are in sole control and are not dependent on the enthusiasm and generosity of others.

The write-up is based on a generic IMRaD formula:

Introduction
Methods
Results
and
Discussion.

The introduction and methods sections are substantially based on the same sections in the study protocol, with the results and discussion sections requiring substantial

new work. The discussion section needs to be written in the context of the study findings. This will require a balanced approach and involves presenting literature both supporting and refuting your study findings. As mentioned earlier, we recommend that you repeat your original literature search at the conclusion of your study to ensure that you are aware of any recent publications of relevance. Clinical relevance and generalisabilty also need to be covered in the discussion section, and in addition, we recommend that you include a section acknowledging limitations and further research prior to your structured conclusion/summary. If you have received significant assistance from others, they should also be acknowledged.

On the day

Publication

A feature of the publication pathway is that you do not have to present in person 'on the day'. However, before submitting your paper, you should show it to colleagues with research experience to ensure that your presentation is the best it can be on its first submission.

Do not expect your paper to be approved on first submission: most papers require some revision after the peer-review process. The reviewers will provide constructive critique that will help improve your paper. Do not take these comments personally. Consider each point in turn and ensure that all are adequately addressed before resubmitting the paper. If all issues are dealt with appropriately, it is highly likely you will succeed.

The marking scheme for published papers is detailed on the College website.

Conference presentations and poster sessions

Conferences must be approved in advance by ACEM and adjudication is provided by FACEMs approved by the College. The same principles of preparation apply as for the clinical components of the examination. Your oral presentation or poster session should be well rehearsed in front of peers. These practice presentations are a good opportunity to find out which questions are 'naturally' generated by your project. It may not be necessary to change your presentation to include an answer to a question if the point is not crucial. In fact, having been asked a question beforehand about a particular issue or detail and having had time to consider your response may be to your advantage on the day!

Ensure that you arrive well ahead of time, including travel considerations if required, and are familiar with the venue and audiovisual arrangements. Your electronic presentation or poster will be required by the conference management ahead of time. Check carefully that everything 'works'.

The timing for your presentation will be strictly regulated. You should be well practised to finish with time for questions afterwards. If you run over time, you will be stopped. Questions may come from the audience in general or, more likely, be dominated by those from the adjudicators. The adjudicators will be particularly interested in your study design, statistical methods, confounders and so on, as their focus is on the process of the project more than simply the results, whereas the general audience is often focused only on the clinical implications. Remember, it is the adjudicators, not general audience, who mark you, so keep this in mind when briefing/choosing your 'test' audiences.

Regardless of your mode of delivery, three adjudicators will mark you. Adjudicators are preselected to ensure that they do not have a conflict of interest with your project. One acts as the designated lead adjudicator, and each marks you independently against specified criteria detailed on the College website. At the end of the session, they meet. If all three mark you as a pass, or if two (including the lead) mark you as a pass, you will be notified on the day that you are successful. However, you may still pass if you

do not fulfil these requirements, as all papers are referred to the Board of Censors for a final decision.

Once you have completed regulation 4.10, your future publishing and presenting activities will become exponentially easier.

Key points

- Work on this component should commence soon after your success in the primary examination.
- Involve a research mentor early and continue to do so.
- Choose a topic that is of interest to you and that you feel will be worthwhile.
- Consider timing as a factor in deciding how to present your research.

Chapter 9

The medical literature

> As we acquire more knowledge, things do not become more comprehensible, but more mysterious.
>
> *Albert Schweitzer*

This chapter is presented in three parts:

- Part A introduces the basic statistics involved in the everyday practice of ordering and interpreting investigations, presented from the perspective of the clinician, not the statistician.
- Part B outlines the process of evidence-based medicine (EBM). This is particularly pertinent for the publication/presentation requirement of advanced training and ACEM Fellowship (see Chapter 8), as well as providing the structure for critical appraisal of the medical literature relevant to all sections of the exam.
- Part C provides key articles, a synopsis of current topical areas where further reading is required and a list of some useful resources on consensus treatment.

This chapter may be utilised in several ways. Those trainees commencing their approach to the fellowship exam, who have the time and motivation to use EBM techniques as a cornerstone of their preparation, may find this a useful summary of what is most relevant to have in their 'tool kit'. Alternatively, those closer to the event may choose to focus their efforts on using the material as a review of information that could be asked in the exam — EBM would lend itself well to being an SAQ or SCE topic. The important papers section has relevance to all parts of the exam for trainees at all stages of their preparation.

Part A: the emergency physician's guide to basic statistics

Consider the following:

> A test has a specificity of 99% and sensitivity of 99% in a population where the prevalence of disease is 1%. What is the positive predictive value (PPV) of this test?

If, like most clinicians, reading this question makes your eyes glaze over and your head ache, this section is for you. We will work our way through the answer step-by-step and by the end of this section, your headache will be gone!

First, consider the possible results of a test (positive or negative) when a disease (or disorder) is present or absent. The possible combinations are shown below.

		Disease	
		Present	Absent
Test result	Positive	True positive (TP)	False positive (FP)
	Negative	False negative (FN)	True negative (TN)

Prevalence

For ease of calculations, we will assume a population size of 10,000. **Prevalence** is the number of people in the population with the condition at a given time. So a prevalence of 1% in our population of 10,000 will therefore equal 100 people with the disease. Prevalence should not be confused with **incidence**, which is the number of presentations per unit of time. For example, the annual *incidence* of diabetes is the number being diagnosed each year, whereas the *prevalence* (the number of people who have diabetes) is much higher.

		Disease		**Total**	
		Present	Absent		
Test result	Positive				
	Negative				
Total		**100**	9,900	**10,000**	**Prevalence 1%**

Sensitivity is the capacity to detect something when it is present — just like a sensitive person does. In statistical terms it is best thought of as 'positivity in the presence of disease' = TP/(TP + FN). Tests with high sensitivity are preferable if the desire is to ensure that a condition is detected or 'ruled in'. For our case, a sensitivity of 99% will result in a total of 99 out of the 100 patients with the disease returning a (true) positive test and one returning a (false) negative test.

		Disease		Total	
		Present	Absent		
Test result	Positive	**99 (TP)**			
	Negative	**1 (FN)**			
Total		**100**	9,900	10,000	Prevalence 1%

Sensitivity 99%

Specificity is the ability of a test to pick *only* the disease — just as being specific means not getting off the point. In statistical terms, specificity can be thought of as 'negativity in the absence of disease' = TN/(TN + FP). Tests with high specificity are preferable when it is important to ensure that a condition is not present, i.e. 'ruled out'. For our example, a specificity of 99% will result in 99 (1%) of the 9,900 without the disease still returning a (false) positive test.

		Disease		Total	
		Present	Absent		
Test result	Positive	99 (TP)	**99 (FP)**		
	Negative	1 (FN)	**9,801 (TN)**		
Total		100	**9,900**	10,000	Prevalence 1%

Sensitivity 99% **Specificity 99%**

The table can now be completed with simple arithmetic.

So far, we have been working backwards from a given population with a known disease prevalence to calculate true and false negatives and positives. However, this is not the world of a clinician with a test result. The result returned will be either positive or negative (at least for the sake of this discussion). The question that the clinician must ask is: 'What does a positive (or negative) test mean?'

Positive predictive value (PPV) and **negative predictive value (NPV)** are the likelihood that a positive (or negative) test is a true result, i.e. what proportion of positive results are true positives and what proportion of negative results are true negatives.

- PPV = TP/(TP + FP)
- NPV = TN/(TN + FN)

This is of direct importance to you as the clinician, as it tells you whether or not you can rely on the result you have. Depending on whether the test was intended to 'rule in' or 'rule out' a particular condition, the focus will be more on the PPV or the NPV, respectively.

		Disease		Total	
		Present	Absent		
Test result	Positive	**99 (TP)**	**99 (FP)**	**198**	**PPV 50%**
	Negative	1 (FN)	9,801 (TN)	9,802	NPV 99.99%
Total		100	9,900	10,000	Prevalence 1%
		Sensitivity 99%	Specificity 99%		Accuracy 99%

The final basic statistical value we can also now calculate is **accuracy**. Accuracy is the proportion of time the test is correct (TP or TN) for the given population.

Accuracy = (TP + TN)/(TP + TN + FP + FN)

This now enables us to answer the original question. A test with a 99% sensitivity and specificity when applied to a population with a disease prevalence of 1% will have a positive predictive value of only 50%.

From this you should now be able to appreciate that prevalence of disease has a significant impact on the clinical interpretation of a test *in addition* to simply evaluating the sensitivity and specificity. A practical example of this is assigning pre-test probabilities to ventilation/perfusion scanning for suspected pulmonary embolism. Assigning a pre-test probability defines the prevalence of disease and hence alters the interpretation of the test result, even though the same test has been performed!

Below is the original question with a prevalence of 10%.

		Disease		Total	
		Present	Absent		
Test result	Positive	990 (TP)	90 (FP)	1,080	PPV 91.7%
	Negative	10 (FN)	8,910 (TN)	8,920	NPV 99.89%
Total		1,000	9,000	10,000	Prevalence 10%
		Sensitivity 99%	Specificity 99%		Accuracy 99%

Note, the PPV has now increased dramatically. If your confidence in basic statistics has now grown (and your headache has gone), try different combinations and permutations of parameters to confirm the effect on PPV and NPV. To start with, review a paper or even work through the detail for an investigation you perform on a regular basis. You may never view basic statistics with fear again!

Part B: an overview of EBM

> Education's purpose is to replace an empty mind with an open one.
>
> *Malcolm Forbes*

The context

> Doctors need to know about the studies that show whether new ideas work, but their volume has grown enormously. What's more, many are published in inaccessible places, are not published at all, or are seriously flawed. Most busy doctors lack the time or skill to track down and evaluate this evidence. Although the skills of searching for evidence and critically appraising it are being mastered by growing numbers of doctors, many cannot keep up. Consequently there is a widening chasm between what we ought to do and what we actually do.

This excerpt from an editorial by Davidoff et al. in the *BMJ* in 1995 still holds true today. EBM comprises the latest information on the most effective or least harmful management for patients (Davidoff et al., 1995). The key processes in EBM are:

1. formulating the management or clinical research question to be answered
2. searching the literature and online databases for applicable research data
3. appraising the evidence gathered with regard to its validity, relevance and generalisability
4. integrating this appraisal with knowledge about the unique aspects of the patient (including patient preferences) (Mark, 2008).

Critical appraisal is 'the process of systematically examining research evidence to assess its validity, results and relevance before using it to inform a decision' (Mark, 2008). It allows the reader to assess in a systematic way how strong or weak a paper is in answering a clinically relevant question or whether the paper can be relied on as the basis for making clinical decisions for patients.

Deficits in knowledge and understanding of the critical appraisal process restrict the implementation of the best available evidence into clinical practice. Recognising the need to understand evidence regarding treatment or diagnostic options for contentious issues is the first step in the journey. This requires an acknowledgment of equipoise (one is not sure which is the better treatment or test). The clinician may then wish to explore the quality of evidence underpinning a proven treatment or test, even if they are aware of these.

Carefully formulating a precise, answerable question that is clinically relevant (i.e. that will provide improved care or a better diagnostic test) is the starting point (**why**). Without knowing the why, there is no point in starting the appraisal journey. The next step is to decide **where** to look for the evidence. Literature searches need to be efficient, comprehensive, unrestricted and unbiased, encompassing explicit search strategies of published, citable literature databases and sources of unpublished research. **How** to identify good-quality studies, critically appraise those selected and apply their findings to individual patient care completes the appraisal journey.

Most readers will not limit their literature search in terms of date of publication (**when**) unless they are confident that a treatment or test was developed only recently, or an unlimited search yields numerous citations, which become unmanageable. As there is often a time lag between study citations being added to searchable databases, it is worthwhile considering conducting a more recent targeted search in relevant journals if the topic area is rapidly evolving. Wang and Bakhai (2006) and Pocock (1983) provide excellent further reading in the area of clinical trials, as do Greenhalgh's 'Education and debate' series from the *BMJ* (Greenhalgh, 1997a) and Gordon Guyatt's 2000 focus series from the *JAMA* (Guyatt, 2000).

Before looking for individual studies, we recommend a concerted search for meta-analyses, which offer a useful background perspective and, if one is lucky, may even answer the research question, using the summated 'quality overall evidence' available so far (Mark, 2008). Meta-analyses are formally designed and properly conducted critical appraisals of intervention trials that attempt to 'aggregate' outcome findings from individual studies if they show a consistent effect. The presence of compelling outcome effects, consistent in direction and size across individual non-clinically heterogeneous studies of acceptable methodological quality, will likely be enough to tell you whether a proposed treatment or diagnostic test will be suited to your patient.

Critics claim that such aggregated findings cannot be applied to an *individual* patient; on average, the treatment effect will be qualitatively similar (if it benefits meta-analysis patients, treatment would probably be effective in your patient) but quantitatively more variable (the magnitude of benefit will vary between patients). The conclusion reached by a meta-analysis will be applicable to your patient and specific clinical setting if these characteristics are comparable to those of the study patients or study settings included in the meta-analysis.

Critically appraising a meta-analysis will still save you time and effort if many intervention trials or studies of diagnostic performance of a certain test relevant to your objective have been carried out. You need to ascertain whether the *methodological rigour and quality* of the meta-analysis is sufficient for conclusions and recommendations contained in the meta-analysis to reliably fulfil your objectives. If a well-conducted and reported meta-analysis is available, re-examining individual studies in detail is less worthwhile, other than for personal interest. However, a meta-analysis will not include influential studies that become available *after* the date of publication of the meta-analysis. Carrying out a date-of-publication limited search for newly emerging studies is thus recommended, to see whether the conclusions reached in the meta-analysis remain consistent with the newer studies. For in-depth information on systematic reviews in health care, see the standard text by Matthias Egger et al. (2001).

There may be no relevant meta-analysis to inform your objectives. If there are too few studies, or the studies are relatively small, excessively clinically heterogeneous or dissimilar, or they show inconsistent and widely varying outcomes, an aggregated outcome in a meta-analysis may not be possible. In these situations, decisions regarding patient management or investigation are based on a critical appraisal of individual studies you believe to be relevant to your practice setting, with the clinical risk–benefit analysis tailored to suit the individual needs of your patient, as well as taking into account treatment feasibility, practicability and availability.

Critical appraisal and clinical practice

Standards of clinical care now demand identification and timely delivery of the most effective treatment available in order to achieve optimal outcomes. There are high expectations among colleagues, patients and health administrators that treatments are clinically effective, cost-effective and timely with minimal adverse effects. In emergency medicine this may also involve the further consideration of time-critical situations. Treatment selection by anecdote, eminence or prior personal experience is no longer acceptable. Emergency physicians must make active, informed decisions regarding treatment selection and not simply default to in-patient teams.

In emergency medicine, critical appraisal of the evidence is most pertinent to time-critical conditions that require non-established or contentious urgent treatments that may be highly beneficial but also lead to significant harm. For example, this situation arises in thrombolytic treatment for acute ischaemic stroke, where treatment administered within three hours of symptom onset gives better neurofunctional outcome, but remains little used for fear of causing intracranial bleeding. ECASS III, a recently published RCT comparing IV alteplase with a placebo in ischaemic stroke,

found alteplase to remain beneficial at three to four and a half hours after symptom onset (Hacke et al., 2008). The most recent Cochrane meta-analysis of thrombolysis trials in stroke, published in 2003, did not include ECASS III (Wardlaw et al., 2003). Evidence is in a constant state of evolution, so critical appraisal is a continuing process that aligns itself with continuing medical education and professional development. Nowadays, studies informing on therapeutic (in)effectiveness are easily and rapidly accessible through user-friendly information technology media such as the 24-hour *medical cybrary*. With the exception of acute resuscitation, there is never an excuse not to evaluate effectiveness *prior* to patient treatment.

High-standard clinical care requires the clinician to correctly select and safely deliver the best available treatment or diagnostic test for each patient in a timely fashion. A poor outcome for a patient receiving the most effective available treatment or a consequential diagnosis missed despite use of the most reliable test is ethically and medico-legally more defensible than the same adverse events in a patient after suboptimal treatment or not receiving an appropriate diagnostic test. The clinician who knows that a poor patient outcome has not resulted in some way from a knowledge gap will sleep the better for it.

Within the realm of clinical research, an unbiased comprehensive literature search is able to identify whether a research question has been answered in previous studies, and therefore whether another study is necessary or even ethical in the presence of compelling evidence. The potential impact on improving patient care and clinical relevance of a proposed study is also assessable by critical examination of the available literature. Furthermore, peer review of medical research manuscripts requires critical appraisal of a study's internal validity as it relates to methodological rigour and its capability to be generalised to various clinical settings.

Barriers and challenges remain in keeping up to date with the latest evidence. The time pressures of increasing demand for hands-on patient care discourage evidence appraisal. This is exacerbated by perceptions that clinical care is distant and divorced from medical research, engendering the negative connotation that critical appraisal by the 'thinker' clinician is a diversionary activity of little relevance to direct patient care rendered by the 'doers'. Negative perceptions exist that medical research has become an industry with little relevance to clinical practice.

Exponential growth in the medical literature and the increasing ease of access to biomedical journals has produced a 'noise to signal ratio' that can easily overwhelm the time-pressured clinician. Successfully identifying, or conversely not missing, crucial studies can be a challenge. The following sections provide a framework to help with this important task.

Levels of evidence

Intervention and non-intervention studies can be stratified into several 'levels of evidence', according to their internal validity and dependability in informing treatment effects. A well-designed and conducted meta-analysis or randomised controlled blinded treatment trial is widely recognised as being able to offer the most reliable and least biased estimate of treatment benefit or harm (Wang et al., 2006), followed in descending order of quality of evidence by observational non-intervention studies such as case control studies and finally case series and case reports. This is variously graded (e.g. levels I–IV or grade A–C recommendations) depending on the body utilising this.

Several issues should be apparent at this stage:

- For trainees, the task of tackling the mountain of literature and targeting the most relevant items to influence practice and prepare for the fellowship exam can be daunting.
- Acquiring the skills necessary to do this will be a lifelong investment in ensuring ongoing professional development.

- For some candidates, the process of seeking out and analysing existing and new offerings will become a pleasurable as well as a necessary pastime. Many will hopefully make important contributions themselves.

ACEM recognises the importance of EBM and research as being crucial for the future of the specialty. It is expected that fellowship exam candidates will be aware of major practice informing papers. The purpose of regulation 4.10 is to ensure that all trainees have exposure to research during their training. This is important so that individuals with a predilection for research can self-select and be supported in their future development.

For the working trainee who is approaching the exam, acquiring and applying EBM skills to each topic on the fellowship curriculum can be daunting. Some would say that this is unrealistic, when so many other priorities exist and time is short. Textbooks and exam-focused resources that have incorporated relatively recent clinical evidence provide an attractively efficient way to capture, in digestible portions, the latest controversy or 'hot topic' in emergency medicine. A great advantage to this approach is that someone else has already critically appraised the key papers for you, saving you from having to do this yourself. However, books are revised only periodically (usually every few years), so what was topical or controversial when a book was written may now be passé or resolved and no longer an attractive topic in the fellowship exam.

In practice, the greatest proportion of a consultant emergency physician's work time is spent 'on the floor', caring for patients directly or providing clinical supervision for registrars and residents. With multiple non-clinical tasks required for a functional Emergency Department, time for critical appraisal of EBM topics may be difficult to access. In terms of emergency medicine advanced training, the bread and butter of clinical emergency medicine remains the focus of the fellowship examination. The regulation 4.10 requirement and an occasional question during the fellowship examination on critical appraisal of the evidence are used to assess the trainee's capacity for skilled self-directed learning and evidence analysis. In the process of achieving the latter aim, some trainees will aspire to becoming research leaders in the future, boosting the research credibility of our specialty.

A tool kit of EBM techniques

Critical appraisal of a single intervention study

It is assumed that you have already conducted an unbiased, reliable and comprehensive literature review. Having identified the article from major biomedical databases such as MEDLINE and EMBASE and others, you are now ready to appraise it. You wish to determine whether it has internal validity and is applicable to the patients you are looking after in the clinical setting in which you practise.

Critical appraisal requires the following questions to be satisfactorily answered.

What is the research question?

If the research question is not precisely stated and clearly defined, useful conclusions are unlikely. Within a critical appraisal process, using a *PICOT* structure is useful. The PICOT characteristics of a study allow you to determine whether its findings are generalisable:

P = study participant characteristics at baseline, including disease severity; study setting
I = experimental intervention or diagnostic test being investigated
C = comparison or control group, usually the standard treatment/test, a placebo or usual care
O = outcomes of interest; clinically meaningful for both the clinician and patient
T = time period of the study observation or period of follow-up.

Are the study results likely to be valid?

A valid intervention trial addresses a clearly focused question with sufficient methodological rigour to enable the results to be trusted. We clearly need to avoid any bias, which occurs when the outcome is materially affected by factors other than the tested intervention. Key issues to assess pertain to trial design and conduct.

Was the trial design valid?

- **Adequate sample size.** Did the study design specify a large enough sample size that will reliably answer the research question? The criteria for sample size calculations are:
  - *The magnitude of the anticipated treatment difference between the intervention and standard treatment:* the larger the anticipated difference, the smaller the sample size required. The treatment difference should not be too small to be clinically irrelevant, nor should it be artificially inflated to reduce sample size requirements.
  - *Baseline event rate:* the higher the expected outcome rate in the standard group, the smaller the sample size required. In simple terms, this is because the intervention will then be administered to a larger disease burden, and therefore be more likely to detect an effect that exists.
  - *Variability in study arms:* the greater variability (as measured by a high standard deviation or variance) in prognostically important characteristics in either study arm, the greater the sample size required. Greater inter-individual variability in the intervention arm implies that its members are relatively different from each other. Baseline differences between individuals, rather than the intervention itself, will then account for a relatively larger proportion of the measured treatment effect.
  - *The power of the study:* this is defined as the probability that the study will detect a truly existing effect of intervention. Most studies are powered to 80–90%, so that they have an 80–90% chance of detecting a true difference if it exists. Conversely, these studies have a 10–20% chance of incurring a false negative finding, of missing a true treatment effect (β error). Power is mathematically equivalent to (1 – β). A more highly powered study requires a larger sample size.
  - *p-value:* this is the probability that an effect equal to or greater than that found in the study will exist, even if there is no real treatment difference in the population. Using the widely accepted *p*-value of 0.05 as the threshold for judging statistical significance, there is a 5% or 1 in 20 chance of this occurring (a 5% chance of a false positive result). If $p > 0.05$, there is an unacceptable probability (> 5%) that a false positive finding has been discerned in the study. The **null hypothesis** of no difference in the population cannot therefore be rejected; conversely, the **alternative hypothesis** of the presence of a real effect difference in the population cannot be accepted.
  - *Attrition:* higher sample sizes, typically in the order of 30% in addition to that calculated, are required to reduce the impact of loss to follow-up. Loss of outcome data, if substantial, will threaten the validity of study results.
- **Randomisation sequence generation and implementation.** Recruited patients should have an equal, quantifiable but random chance of being allocated either the experimental or control treatment. This preserves equity of access and respects therapeutic equipoise, as it is not clear which treatment offers greater benefit. Successful randomisation of an adequate number of patients results in study groups that are, on average, similar in all characteristics associated with the outcome of interest. Prognostically influential baseline factors such as age and

baseline disease severity should be equally distributed in each study arm, removing any confounding effects on the results. Articles usually include a table that compares the characteristics of each group; note any significant differences.

- **Allocation concealment.** This requires the investigator and the patient to be deliberately kept unaware of which arm they will be entered into. Allocation concealment prevents the recruiting clinician or patient basing their participation on being given their preferred treatment. For example, a patient with poor prognosis for whom standard treatment has failed previously may decline to participate if offered standard treatment again, believing it to be futile. Patient or clinician treatment preference that is consequentially related to prognosis or study outcomes is thereby prevented (avoids selection bias).
- **Blinding.** After allocation, the patient, clinician and outcome assessor ideally should not know what treatment the patient is assigned to. Treatments that are identical in all ways except for the presence of the active agent may be used (e.g. use of placebo tablets that look and taste identical to the active tablet). Blinding reduces the risk of biased outcomes from pre-existing attitudes/beliefs about treatment efficacy or harm. The patient may report more *apparent* benefit if they believe the active treatment is better and are aware that they are receiving it. Similarly, an outcome assessor who knows the patient has received active treatment may tend to overestimate benefits if the assessor believes the active treatment to be superior.

Was the conduct of the trial valid?

- **Completeness of follow-up.** Differential attrition rates (withdrawal from study, lost to follow-up) between groups lead to post-randomisation selection bias. For example, drop-outs due to severe toxicity from the intervention lead to more outcome data being available from patients who did not experience toxicity (bias in favour of treatment). Alternatively, a patient may feel so well after achieving superior outcomes from the intervention that they prematurely leave the study, leading to more outcome data being available from patients who do not respond as well (bias against treatment). A flow chart describing attrition at various stages of the study allows such post-randomisation selection bias to be assessed.
- **Study group treatment equivalence.** Apart from the study treatment allocation, all study subjects should ideally be treated equally in terms of the frequency and timing of follow-up, investigations carried out to assess outcome or adverse effects and receipt of more aggressive co-treatment. The clinician who is aware that a patient is receiving what the clinician considers to be inferior treatment may intensify supplementary treatment and be more vigilant for signs of disease progression or adverse effects. Biased outcomes result from underestimation of benefit and overcalling harm associated with treatment considered inferior. The opposite may occur for 'superior' treatment.

Was the analysis of the trial findings valid?

Intention to treat analysis

All patients should be analysed in the group to which they were randomised. Loss to follow-up greater than 20%, especially if differentially distributed between groups, will lead to post-randomisation bias if **intention to treat (ITT) analysis** is not used. ITT analysis means that patients are analysed according to the treatment group to which they were randomised, irrespective of whether they underwent the intended intervention or whether they adhered to protocol stipulations. ITT analysis results in an unbiased estimate of effect and more closely reflects what happens in real-life clinical practice, where patients have a range of compliance with treatment recommendations. In contrast, **per protocol analysis** is biased, since it includes

only comparisons between patients who adhere to the treatment allocated to them. If the tested treatment works, the measured effect of the same treatment in the same study will be greater in magnitude for per protocol analysis (where only compliant patients are included in the analysis) compared with ITT analysis (where all patient outcomes are included in the analysis whether patients comply with the treatment or not).

Statistical method

The statistical method used should be pre-specified and appropriate to the study objectives. The appropriate method depends on the outcome type (e.g. continuous variables such as BP results versus binary variables such as alive/dead) and the anticipated distribution of results (parametric tests for normally distributed data and non-parametric tests for non-normally distributed data; a transformation of raw data to approximate normality may be required). Pre-specified statistical methodology assures the reader that in the face of unimpressive or unexpected results, alternative analyses have *not* been used to achieve more impressive or desirable findings.

The use of post-hoc subgroup analyses, unjustified multiple outcome or interim comparisons will likely lead to a false positive finding in a small study subset (the more analyses are done, the more the risk of a false positive finding). However, it is reasonable to conduct post-hoc analysis adjustments if results indicate the method initially chosen is no longer valid. For example, a study may have been designed expecting normally distributed data, but non-normal distribution of data is unexpectedly encountered. In this situation, non-parametric methods will be required. Interested readers are referred to standard texts (Kirkwood et al., 2003) and user-friendly articles (Greenhalgh 1997b; 1997c).

What are the results?

Measures of treatment effect

Treatment effects of binary outcomes can be presented as an **absolute** difference (such as a risk difference), a **relative** difference (odds ratio or a risk ratio) or a **relative risk** (risk experimental group/risk standard group). Treatment effects of continuous measurements are usually analysed as absolute differences: for example, (mean blood pressure experimental group) – (mean blood pressure standard group).

In a parallel group treatment trial an experimental treatment is being compared with standard treatment and patients are followed up for an outcome of interest (such as a specific benefit or harmful event such as death). Other metrics are used that are assisted by an outcomes matrix:

	Experimental treatment	Standard treatment	Margin totals
Experienced outcome	a	b	$a + b$
Did not experience outcome	c	d	$c + d$
Margin totals	$a + c$	$b + d$	$N = a + b + c + d$

- **Risk of outcome occurring in experimental treatment group**
  = proportion of patients in experimental arm who experience outcome of interest
  = $a/(a + c)$
- **Risk of outcome occurring in standard treatment group**
  = proportion of patients in standard treatment group who experience outcome of interest
  = $b/(b + d)$

- **Absolute risk difference** (experimental versus standard)
  = (risk of outcome occurring in experimental treatment group) – (risk of outcome occurring in standard treatment group)
  = $(a/[a + c]) - (b/[b + d])$
  The absolute risk difference is the percentage of additional (or fewer) patients allocated experimental treatment who develop the outcome of interest compared with the standard treatment.
- **Relative risk** (experimental versus standard)
  = (risk of outcome occurring in experimental treatment group)/(risk of outcome occurring in standard treatment group)
  = $(a/[a + c])/(b/[b + d])$
  The relative risk measures the potential impact of the experimental treatment in reducing (or elevating) the risk of an outcome of interest, when compared with standard treatment.
- **Odds of favourable outcome occurring**
  = number of patients experiencing outcome/number of patients not experiencing outcome
  For experimental treatment group, odds of favourable outcome = a/c.
  For standard treatment group, odds of favourable outcome = b/d.
- **Odds ratio of favourable outcome** (experimental versus standard)
  = (odds of favourable outcome for experimental treatment group)/(odds of favourable outcome for standard treatment group)
  = $(a/c)/(b/d)$

Absolute odds difference is not meaningful in a statistical sense. Odds ratios have similar characteristics and application to the risk ratio, and although frequently used in intervention studies, are more valid to be applied to case control studies.

It is important that the results section presents both absolute and relative treatment effect measures. The latter usually gives an exaggerated impression of treatment effect if presented in isolation. In a hypothetical example comparing treatments X and Y, if beneficial outcome occurs in 4% on treatment X and 2% on treatment Y, the *absolute* risk difference is (4 – 2%) = 2% which is not particularly impressive. The *relative* risk of benefit of treatment X compared with Y is calculated as:

Risk treatment X/risk treatment Y = (4/2) = 2

If the author selectively presents *only* the relative risk, the reader will be led into thinking, and not incorrectly, that treatment X is twice as effective as treatment Y, but without any contextual awareness that only two out of every 100 patients attain greater benefit from treatment X. Although treatment X is better, its absolute impact is nowhere near as impressive as the relative risk suggests.

Number needed to treat

Patients and health resource allocators need a more practical and intuitive way to understand the benefit or harm of a treatment offered to them or that they have been asked to fund. The **number needed to treat (NNT)** for benefit (or harm) translates previously discussed treatment effects into a more meaningful 'How many patients do I need to treat before one of them experiences a benefit or harm?'

When we look at treatment benefit, the NNT to benefit is equivalent to (1/absolute risk difference). It is clear from this formula that the greater the absolute risk difference conferred by a treatment (the denominator), the smaller the number of patients required to be treated before one experiences a benefit. Using the previous example, where absolute risk difference is 2% benefit conferred by treatment X, the NNT for benefit is (1/0.02) = 50 for one patient to benefit. Although the relative risk of a benefit is 200% when X is compared with Y, 50 patients must be treated with X to obtain benefit for one, reflecting the small absolute risk benefit conferred by X.

Effect size

The higher the risk ratio, the more likely that the outcome will be different between the experimental and standard treatment in the real patient population. For example, for a given disease, a risk ratio of cure of 10 suggests a treatment is five times more likely to be beneficial compared to another treatment associated with a risk ratio of 2.

Precision of treatment estimates

The **95% confidence interval (95% CI)** reflects the uncertainty of the study point estimate, informing the reader that the true population-level effect is likely to lie within this interval with 95% probability. The main results from a trial are best presented in terms of some treatment effect together with a confidence interval and (usually) a *p*-value.

How might the results be applied?

The final step is to consider the applicability of the results to your patients. This includes the similarity of their characteristics to trial patients and the practicalities of reproducing the study environment in your centre. The associated risks, costs, size and clinical significance of the treatment effect from both the patient's and the institution's viewpoints are practically important in deciding whether to introduce a new therapy in your workplace.

An example of the application of these statistical factors and their clinical relevance is provided in Table 9.1 pertaining to the ECASS III study. A reasonable interpretation of this study could be that:

> . . . for adult stroke patients similar to those enrolled in ECASS III (18–80 years admitted to a stroke centre with a diagnosis of acute ischaemic stroke able to receive the study drug within three to four hours after symptom onset), the number needed to treat to achieve a neurofunctional benefit (1 in 14) is far fewer than that required to harm (1 in 46 will

TABLE 9.1 Brief statistical analysis of ECASS III study

52.4% of ischemic stroke patients had a favourable neurological outcome with IV alteplase compared with 45.2% with placebo

Absolute risk difference for favourable outcome (alteplase vs placebo) = 52.4 – 45.2 % = 7.2%.

Relative risk for favourable outcome (alteplase vs placebo) = 52.4/45.2 = 1.16 (i.e. alteplase was associated with 16% greater risk of patients having a favourable outcome (this risk ratio was not given in the study)).

Number needed to treat for benefit = 1/absolute risk difference for favourable outcome = 1/7.2% = 13.9 (i.e. we need to administer alteplase to approximately 14 patients for one of them to benefit).

Odds ratio for favourable outcome (alteplase vs placebo) is 1.28 with 95% CI, 1.00 to 1.65, $p < 0.05$. This means that there is a 28% greater chance for a favourable outcome with alteplase compared with the placebo. However, the lower end of the 95% CI touches the OR of 1. The true population effect lies with 95% probability within the interval from (nearly 0%) to 65% greater relative odds of favourable outcome with alteplase, with the best estimate from the study being 28%. As such, the *p*-value is likely to be just *slightly* under 0.05.

2.4% of patients given alteplase had symptomatic intracranial haemorrhage compared to 0.2% on the placebo (p = 0.008), although there was no mortality difference (7.7% v 8.4%, p = 0.68).

Alteplase incurs an additional absolute risk incidence of (2.4 – 0.2%) = 2.2% for symptomatic intracranial haemorrhage compared with placebo, with the number needed to harm = 1/(absolute risk increase for harm)
= 1/(2.2%) = 45.45.

Source: Hacke W, Kaste M, Bluhmki E et al. Thrombolysis with alteplase 3 to 4.5 hours after acute ischemic stroke. N Engl J Med 2008; 359:1317–1329.

suffer symptomatic intracranial haemorrhage). Despite increased risk of intracranial haemorrhage with alteplase, there was no mortality difference.

The patient could be told: 'You have a much greater chance of recovering well from this stroke with alteplase than having a brain bleed from it.'

Critical appraisal of meta-analyses

Meta-analysis combines and summarises available research evidence quantitatively. If this is not possible, a more narrative systematic review is produced. Meta-analyses are most frequently and usefully employed to combine the effect estimates from multiple randomised controlled intervention trials. An explicit, rational and comprehensive search strategy is applied to all sources of literature pertinent to a treatment topic. Unpublished or non-database cited trials should be identified and included to avoid publication bias ('positive' and English language trials are more likely to be published); this requires a search of 'grey literature' such as conference abstracts and theses and communication with researchers in the area. For single studies to be eligible for inclusion in a meta-analysis, they have to be independently evaluated by two or more assessors as being of sufficient quality. These criteria are similar to those used to appraise single intervention studies.

The most valid meta-analyses obtain and analyse the disaggregated *individual-level* patient data from single trials rather than working only with aggregate data from single studies. The quality of design and conduct of meta-analyses must be appraised to ensure that their findings and conclusions are valid. The results of a well-designed and performed meta-analysis are likely to be most persuasive if it includes at least several good large-scale RCTs, the effect estimates from single studies are consistent, and the number of studies are sufficient and not clinically heterogeneous (i.e. are of similar clinical design). In cases where the available trials are small or poorly done, meta-analysis cannot compensate for the deficient primary trial data.

Forest plots are a visually excellent way to present results from meta-analyses. The general principles in assessing forest plots are:

- Look for consistent treatment effect in individual studies; that is, do the 95% CIs for included studies overlap in the main?
- Assess whether the 95% CIs encompass the vertical line, which indicates neutral or no effect; that is, there is no conclusive effect difference between the treatment and the control.
- Assess whether the 95% CIs are narrow (indicating a well-powered study) or very wide (inconclusive as sample size relatively small for study objectives).
- Assess whether individual studies are proportionately weighed according to their size in their relative contribution to the overall aggregated effect.
- Assess whether meta-analysis was valid to be used to derive an overall aggregated effect: non-overlapping 95% CIs that are distributed on both sides of the vertical line are either clinically or statistically too heterogeneous to combine.

We present two hypothetical meta-analyses for interventions to reduce the risk of failing the fellowship examination in Figures 9.1 and 9.2.

In Figure 9.1 there are only two studies available, A and B. Both studies have the majority of their 95% CI consistently to one side (left) of the vertical line of no effect. Both A and B are *suggestive* that an 18-month study phase reduces risk of failure (the risk ratio of failure is 0.6 and 0.5, respectively, with most of the 95% CI to the left of the vertical line). However, the upper limit of 95% CIs for A and B also extends to the right of the vertical line, so that an 18-month study phase may well *increase* the risk of failure by a factor of 3.5 and 1.05, respectively.

- Study A is relatively small with a wide CI, so A contributes less than B to the overall risk ratio.

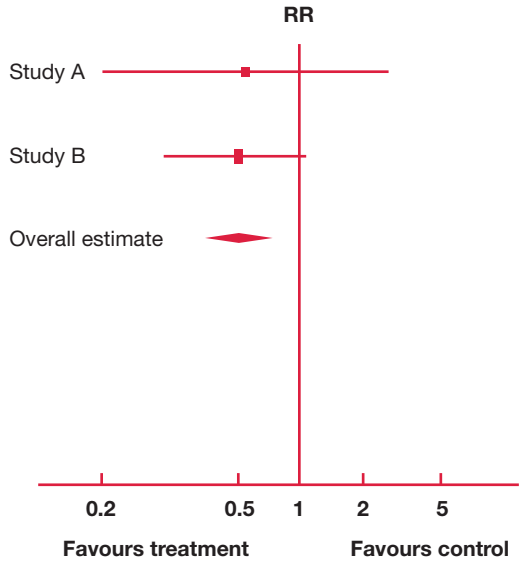


Figure 9.1 Hypothetical forest plot: 18-month versus 12-month (control) preparation time and success in the fellowship examination

- Study B has a much narrower CI, so it contributes most of the weighting to the overall risk ratio; this is reflected in similar 95% CIs for B and the overall risk ratio.

Avoiding failure using an 18-month study phase is not definitely proven, as the upper limit of the overall risk ratio is 1.0 (an 18-month study phase may not reduce your risk of failing the exam, but it is unlikely to exacerbate that risk); this is reflected in a *p*-value close to 0.05 (it achieves marginal statistical significance).

In Figure 9.2 there are four studies comparing the effect of attendance at weekly teaching sessions for six months and taking a three-month overseas holiday on failure in the fellowship examination. The individual study effects are inconsistent:

- A and B show compellingly high odds of failure with the treatment (taking the overseas holiday), with both 95% CIs located to the right of the vertical line.
- C is inconclusive with a wide 95% CI spanning both sides of the vertical line (there is little to choose between attendance at weekly teaching sessions for six months compared with taking a three-month overseas holiday, but the study is likely to be underpowered).
- D is more convincing than C as it has a much narrower 95% CI; this study suggests no difference between attending weekly teaching sessions for six months and taking a three-month overseas holiday.

The overall effect is convincing though, with a three-month overseas holiday associated with a high odds of failure compared with attendance at weekly teaching sessions for six months.

However, since the effect estimations and 95% CI for individual studies are so variable, is it appropriate to aggregate their results in producing an overall estimate?

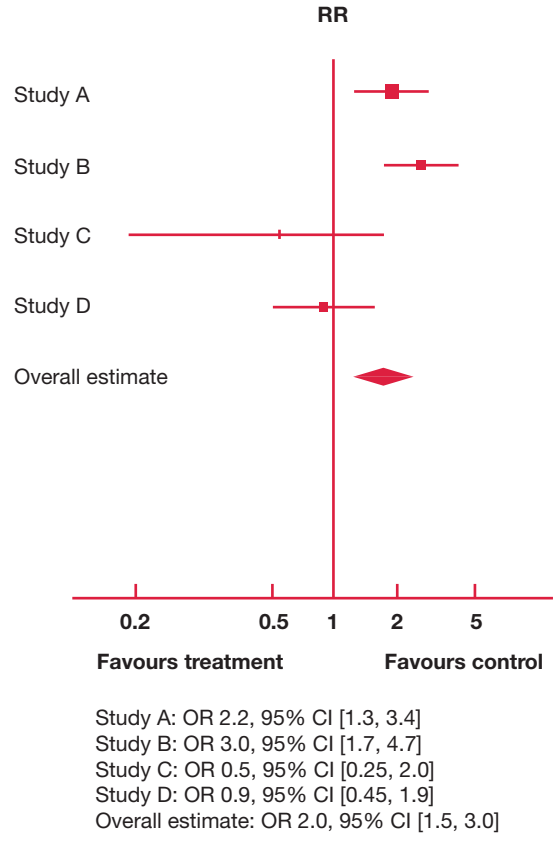


Figure 9.2 Hypothetical forest plot: overseas holiday versus weekly teaching sessions (control) and success in the fellowship examination

Part C: important papers

> The pen is mightier than the sword.
>
> *Unknown*

This section is divided into three groups of papers. First, brief synopses of a selection of important original studies and meta-analyses are presented together with their substantial contribution to evidence-based clinical practice in emergency medicine. These are not presented in any particular order, since all articles in this collection are deemed to be equally important. Next, some papers highlighting controversies and unanswered questions are provided to stimulate you to consider areas of ongoing debate. Some of the issues raised may surprise those who are unaware that the level of evidence supporting some widely employed therapies is not as robust as they once thought. Finally, useful resources that combine evidence from multiple sources into easy-to-use practice recommendations are presented. We encourage you to add to all of these sections during your exam preparations.

Lessons from original papers that have shaped emergency medicine

Validated decision rules have helped to rationalise emergency physicians' approach to investigations and clinical risk stratification.

The greatest work has been done in low-risk trauma patients to reduce radiographic imaging (e.g. minor head injury, low-risk cervical spine injury, ankle injuries (Ottawa)); however, work is ongoing to develop validated decision rules for other patient cohorts (e.g. San Francisco Syncope rules). A recent international survey identified emergency physicians' priorities:

- Eagles D, Stiell I, Clement C et al. International survey of emergency physicians' priorities for clinical decision rules. Acad Emerg Med 2008; 15:177–182. The top 10 priorities identified were:
  - investigation of the febrile child < 36 months
  - identification of central or serious vertigo
  - lumbar puncture or admission of febrile child < 3 months
  - imaging for suspected transient ischaemic attack
  - admission for anterior chest pain
  - CT angiography for pulmonary embolism
  - admission for suicide risk
  - ultrasound for pain or bleeding in the first trimester of pregnancy
  - non-specific weakness in the elderly
  - rational use of CT imaging for abdominal pain.

  The following are two excellent examples of work that has led the way:
- Stiell IG, Clement CM, McKnight RD et al. The Canadian C-spine rule versus the NEXUS low risk criteria in patients with trauma. NEJM 2003; 349:2510–2518. The National Emergency X-Radiography Utilization Study (NEXUS), first described in 1992, concluded that cervical spine radiography is indicated for patients with trauma unless they meet all the following criteria: no posterior midline cervical spine tenderness, no evidence of intoxication, normal alertness, no focal neurologic deficit and no painful distracting injuries. The Canadian C-spine (CCR) rules are a flow chart algorithm for alert stable individuals with a GCS of 15, commencing with risk factors for injury (high-risk features being age > 64 years, dangerous injury mechanisms, paraesthesia in the extremities). If no high-risk features are present, low-risk factors allowing safe assessment of range of motion are sought (e.g. low-risk mechanism, ambulatory at any time after injury, delayed onset of pain, absence of midline tenderness). Patients who have low-risk criteria progress to assessment of active neck rotation of 45 degrees to the right and left; if they do this successfully, their cervical spine is safely cleared without the need for radiography. This study involved 8,283 patients and found that the CCR rules were superior to NEXUS and can safely reduce the rates of radiography in this low-risk, high-volume patient group.
- Stiell IG, Clement CM, Rowe BH et al. Comparison of the Canadian CT Head Rule and the New Orleans Criteria in patients with minor head injury. JAMA 2005; 294:1511–1518. The Canadian CT Head Rules (CCHR), reported in the *Lancet* in 2001, were applied in a multi-centre study that included 2,707 patients presenting to ED with blunt head trauma with witnessed loss of consciousness, disorientation or amnesia and a GCS of 13–15. The performance characteristic of the CCHR and the New Orleans Criteria (NOC) were compared in a subgroup of 1,822 patients with a GCS of 15. The CCHR states that a CT scan of the

head is required only in patients with minor head injury if there are any of the following criteria: a GCS of 13–15 after witnessed loss of consciousness, amnesia or confusion. High-risk criteria for needing neurosurgical intervention are age 65 years or greater, having had two or more vomits, signs of base of skull fracture or a GCS less than 15 at two hours post injury. Medium-risk criteria for neurosurgical intervention include retrograde amnesia of 30 or more minutes or a high-risk injury mechanism.

The NOC is applicable to patients with a GCS of 15 and states that a CT scan of the head is indicated if there is at least one finding of either headache, vomiting, age over 60 years, drug or alcohol intoxication, persistent anterograde amnesia, visible trauma above the clavicle or seizure. The study found that for patients with a GCS of 15 the two rules have equivalent sensitivity of 100% for neurosurgical intervention and clinically important brain injury but CCHR was more specific. In the GCS 13–15 group, CCHR had 100% sensitivity for the same outcome.

Sepsis is now managed as a medical emergency and the concept of the 'golden hour' of aggressive goal-directed resuscitation commencing urgently in ED is firmly established.

- Rivers E, Nguyen B, Havstad S et al. Early goal-directed therapy in the treatment of severe sepsis and septic shock. N Engl J Med 2001; 345:1368–1377. This prospective, randomised study enrolled 263 adult patients with severe sepsis or septic shock to receive either six hours of goal-directed therapy or standard therapy prior to ICU admission. An in-hospital mortality improvement was demonstrated (30.5% versus 46.5%) as well as superior physiologic parameters and lower illness severity (APACHE II scores). Goal-directed therapy employed invasive haemodynamic monitoring (Edwards Lifesciences $ScvO_2$ central venous line and an arterial line) and used a step-wise algorithm to achieve CVP 8–12 mmHg, MAP 65–90 mmHg and $ScvO_2 > 70\%$. This involved fluid boluses, vasopressors, inotropes and packed red cell transfusions. It is unclear, however, how this translates to ED practice. The current evidence-based recommendations for sepsis management are elucidated more fully in the most recent 2008 Surviving Sepsis Campaign guidelines (see page 218).

Saline and albumin are both safe resuscitation fluids, although saline should be favoured in patients with traumatic brain injury.

- The SAFE Investigators: Effect of baseline serum albumin concentration on outcome of resuscitation with albumin or saline in patients in intensive care units: analysis of data from the saline versus albumin fluid evaluation (SAFE) study. BMJ 2006; 333:1044. Epub 2006 Oct 13. The crystalloid versus colloid debate was fuelled in 1998 by the Cochrane Injuries Group Albumin Reviewers who reported that their meta-analysis had demonstrated a 6% absolute increase in the risk of death associated with albumin. The Australian and New Zealand Intensive Care Society Clinical Trials Group published the SAFE study in 2006 to address the issue of albumin's safety. Their multi-centre randomised blinded trial enrolled 6,996 heterogeneous patients admitted to ICU requiring intravascular fluid resuscitation during the next 28 days to receive either 4% albumin or normal saline. No significant difference was found in outcomes at 28 days with regards to death, organ failures or ICU length of stay.

The study did not involve patients with burns and those undergoing cardiac surgery or liver transplantation. Interestingly, the ratio of albumin to saline administered over the first four days ranged from 1:1.2 to 1:1.6, refuting previous dogmas suggesting much higher ratios are necessary for equivalent clinical effects. A post-hoc subgroup analysis alerted SAFE study investigators that patients with traumatic brain injury (TBI) resuscitated with albumin had a higher mortality, which instigated longer-term follow-up in this potentially at-risk patient group, a study published in 2007 (the next citation).

- The SAFE Investigators: Saline or albumin for fluid resuscitation in patients with traumatic brain injury. N Engl J Med 2007 Aug 30; 357(9):874–884. The 460 patients with TBI (231 had received albumin and 229 saline) were followed for up to 24 months. Baseline demographic and severity indices were similar, but significantly more patients in the albumin group died. This effect was seen in the most severe TBI subgroup (GCS < 9) but was not statistically significant in the subgroup presenting with a GCS of 9–12.

Therapeutic hypothermia improves neurologic outcome after out-of-hospital cardiac arrest.

Two landmark studies were published in the same edition of the *New England Journal of Medicine* in 2002. They both employed specific interventions to improve cardiac outcome in all patients (i.e. reperfusion techniques if appropriate) and concluded that there was a significant neurologic outcome benefit associated with active cooling. Ongoing work is being performed to elucidate the most optimal therapeutic hypothermia regimen. The effects of this intervention on conventional prognostication strategies in ICU are also undergoing careful re-evaluation, with significant potential confounding effects of adjunctive sedation, particularly in the presence of renal and/or liver dysfunction. There were a number of differences in the methods of each paper:

- Hypothermia After Cardiac Arrest Study Group. Mild therapeutic hypothermia to improve the neurologic outcome after cardiac arrest. N Engl J Med 2002; 346:549–556. This multi-centre Austrian randomised study compared 24 hours of mild hypothermia (32 to 34 degrees achieved with sedation paralysis and external cooling) to normothermia in 136 adult survivors (young women were eligible) of witnessed out-of-hospital VF/pulseless VT arrests with an estimated interval of 5 to 15 minutes from collapse to commencement of resuscitation and not more than an hour of CPR before return of spontaneous circulation. Passive rewarming was utilised.
- Bernard S, Gray TW, Buist MD et al. Treatment of comatose survivors of out-of-hospital cardiac arrest with induced hypothermia. N Engl J Med 2002; 346:557–563. This Australian multi-centre randomised study enrolled 77 patients and compared 12 hours of mild hypothermia (33 degrees achieved with external cooling techniques as well as sedation and paralysis) with normothermia in persistently comatose survivors of out-of-hospital VF arrests. Women under 50 were excluded because of a pregnancy risk. Active rewarming after 18 hours was performed if necessary.

  The Australian investigators are currently studying whether pre-hospital cooling by ambulance paramedics will add any additional benefit. The first of these trials was ceased during interim analysis for futility regarding benefit. With methodological changes, particularly earlier cooling, this remains an area of active research.

Amiodarone is superior to lignocaine as a first-line therapy for refractory VF.

- Dorian P, Cass D, Schwartz B et al. Amiodarone as compared with lidocaine for shock-refractory ventricular fibrillation. N Engl J Med 2002; 346:884–890. Prior to the publication of this article, lidocaine (lignocaine) was the first-line recommended drug therapy for VF refractory to defibrillation. Dorian et al.'s Canadian randomised pre-hospital trial involved 347 patients with out-of-hospital VF resistant to three initial shocks, IV adrenaline and a further shock or who had recurrent VF after initial successful defibrillation. Patients received either amiodarone (5 mg/kg) or lignocaine (1.5 mg/kg) and a second dose if VF persisted (amiodarone 2.5 mg/kg or lignocaine 1.5 mg/kg). Significantly higher rates of survival to hospital admission were found with amiodarone (22.8% versus 12%). There was, unfortunately, no statistically significant difference in rates of survival to hospital discharge, although the study was not adequately powered to detect this.

It is possible to identify patients with community-acquired pneumonia who can be safely managed as outpatients.

- Fine MJ, Auble TE, Yealy DM et al. A prediction rule to identify low risk patients with community-acquired pneumonia. N Engl J Med 1997; 336:243–250. This relates to treatment recommendation in therapeutic guidelines for class I–V pneumonia. Based on analysis of a data set of 14,199 adult in-patients with community-acquired pneumonia a prediction rule was derived that stratifies people into five classes with respect to 30-day risk of death. The rule was then validated. The rule assigns points based on age, coexisting diseases, abnormal physical findings (respiratory rate, temperature) and abnormal lab findings (pH, blood urea, serum sodium). Each of the five classes was associated with an increased mortality risk and need for in-patient care, including ICU management. This paper has been widely referenced and is the basis for recommendations for antibiotic and clinical management in the Victorian Medical Council Therapeutics Committee Antibiotic Guidelines.

Thrombolysis improves the outcome of acute myocardial infarction.

It has been more than two decades since the benefits of thrombolysis in acute myocardial infarction were established with the initial streptokinase studies, embedding the 'unstable plaque theory' (GISSI-1, ISIS-2). Subsequent studies compared streptokinase to tissue plasminogen activator (rt-PA) and examined the role of adjuvant heparin therapy (GISSI-2, ISIS-3, GUSTO-1). The subsequent era compared different agents/regimens of thrombolytic agents (i.e. -teplases) and types of heparin (GUSTO-III, ASSENT-2 and 3). This era of 'mega-trials' paved the way for the ongoing wave of massive, high-quality randomised controlled trials driving the cardiology literature and clinical practice. It is interesting to review the original study:

- Randomised trial of intravenous streptokinase, oral aspirin, or neither among 17,187 cases of suspected acute myocardial infarction: ISIS-2 (Second International Study of Infarct Survival) Collaborative Group. Lancet 1988; 2(8607):349–360. This multi-centre randomised, factorial placebo-controlled study enrolled 17,187 patients within 24 hours after the onset of suspected acute myocardial infarction to receive a one-hour infusion of streptokinase (1.5 million units), one

month of aspirin (160 mg/day), both or neither active treatments. A significant reduction in death, reinfarction and stroke was found in the streptokinase and aspirin group. Mortality reduction was 25% from streptokinase as a single agent, 23% for aspirin alone and 42% with combined therapy.

Coronary angioplasty is superior to thrombolysis, particularly in cardiogenic shock.

A number of large studies have compared these two therapies, commencing with the GUSTO Angiographic Investigators study:

- The GUSTO Angiographic Investigators. The effects of tissue plasminogen activator, streptokinase, or both on coronary-artery patency, ventricular function, and survival after acute myocardial infarction. N Engl J Med 1993; 329:1615–1622. [Erratum, N Engl J Med 1994; 330:516.]

A Cochrane review in 2003 identified 10 relevant trials including 2,573 subjects and concluded that angioplasty provides a short-term clinical advantage over thrombolysis that may not be sustained:

- Cucherat M, Bonnefoy E, Tremeau G. Primary angioplasty versus intravenous thrombolysis for acute myocardial infarction. Cochrane Database Syst Rev 2003 (3): CD001560.

Best-practice guidelines reflect that percutaneous interventions, when available in a timely fashion, are generally superior to lysis, particularly in patients with high-risk features (hypotension, elderly, recent surgery or trauma). Angioplasty has consistently been considered superior to lysis in the population with infarction-related cardiogenic shock:

- Hochman JS, Sleeper LA, Webb JG et al. Early revascularization in acute myocardial infarction complicated by cardiogenic shock. SHOCK Investigators. Should we emergently revascularize occluded coronaries for cardiogenic shock. N Engl J Med 1999; 341:625–634.

Patients with shock due to left ventricular failure complicating myocardial infarction were randomised to emergency revascularisation with coronary artery bypass grafting or angioplasty or received medical therapy with thrombolysis. Most patients in both groups (86%) were also supported with intra-aortic balloon pumps.

A subset of patients with ischaemic stroke benefits from thrombolytic therapy.

Evidence supporting a role for thrombolysis in patients with acute ischaemic strokes has been available for many years and yet application of this therapy has been limited with variable uptake, largely because patients frequently present late and some polarisation persists regarding the risks of intracranial haemorrhage compared with the actual clinical benefits of lysis. Arguably the European Cooperative Acute Stroke Study (ECASS) group has made the most substantial contribution over time to the still controversial risk/benefit argument surrounding lysis in stroke, importantly igniting a more optimistic approach to stroke management:

- Hacke W, Kaste M, Fieschi C et al. Intravenous thrombolysis with recombinant tissue plasminogen activator for acute hemispheric stroke: the European Cooperative Acute Stroke Study (ECASS). JAMA 1995; 274:1017–1025.
- Hacke W, Kaste M, Fieschi C et al. Randomised double-blind placebo-controlled trial of thrombolytic therapy with intravenous alteplase in acute ischaemic stroke (ECASS II). Lancet 1998; 352:1245–1251.

- Hacke W, Kaste M, Bluhmki E et al. Thrombolysis with alteplase 3 to 4.5 hours after acute ischemic stroke. N Engl J Med 2008 Sep 25; 359(13):1317–1329.

It should be acknowledged, however, that a number of other stroke research groups have contributed, and the following systematic review is testament to this:

- Hacke W, Donnan G, Fieschi C et al. Association of outcome with early stroke treatment: pooled analysis of ATLANTIS, ECASS, and NINDS rt-PA stroke trials. Lancet 2004; 363:768–774. This meta-analysis combined the results of six randomised controlled trials involving 2,775 patients treated within 360 minutes of stroke onset with rt-PA or a placebo. A favourable neurologic outcome at three months was associated with lysis, which increased as time to receipt of thrombolysis decreased. The risk of intracranial haemorrhage was 5.9% (lysis group) versus 1.1% (control group) and unrelated to the time to treatment.

In contrast, a major development that has become widely recognised for stroke care is the role of dedicated multidisciplinary stroke units with protocols for medical, nursing and therapy interventions that energetically and optimistically embrace aggressive rehabilitation. Improvements in mortality and reduced dependency have been demonstrated.

Aspirin prevents strokes and improves mortality.

In the mid-1990s a number of trials established the safety and efficacy of aspirin after acute ischaemic stroke. References for the two leading landmark papers, presented in the same volume of the *Lancet*, are provided. This is followed by a recent meta-analysis on this issue:

- CAST: randomized placebo-controlled trial of early aspirin use in 20,000 patients with acute ischaemic stroke. CAST (Chinese Acute Stroke Trial) Collaborative Group. Lancet 1997; 349:1641–1649.
- The International Stroke Trial (IST): a randomised trial of aspirin, subcutaneous heparin, both, or neither among 19,435 patients with acute ischaemic stroke. International Stroke Trial Collaborative Group. Lancet 1997; 349:1569–1581.
- Sandercock P, Counsell C, Gubitz G, Tseng M. Antiplatelet therapy for acute ischaemic stroke. Cochrane Database Syst Rev 2008: CD000029. In 12 trials, 43,041 patients were treated with aspirin (160–300 mg daily) started within 48 hours of the onset of non-haemorrhagic stroke versus a placebo. The number needed to treat to avoid death or dependency is 79 without a major risk of early haemorrhagic complications.

Activated charcoal is the decontaminant of choice for drugs that may adsorb to this agent.

- Pond S, Lewis-Driver D, Williams G, Green A, Stevenson N. Gastric emptying in acute overdose: a prospective randomized controlled trial. Med J Aust 1995; 163:345–349. This Australian randomised study enrolled 876 adult patients who presented to ED after ingesting an overdose of one or more compounds able to be absorbed by activated charcoal. One group received charcoal alone and the other first had gastric emptying attempted with ipecac-induced emesis or gastric lavage. There was no difference in the clinical course, length of hospital stay or complications between the groups, with the conclusion that charcoal alone is appropriate. This study changed the face of ED management of overdoses. The

role of charcoal remains the subject of ongoing research, including the role of multi-dose activated charcoal for 'gastrointestinal dialysis'.

High-dose nitrates and low-dose frusemide are beneficial in acute pulmonary oedema without shock.

- Cotter G, Metzkor E, Kaluski E et al. Randomised trial of high-dose isosorbide dinitrate plus low-dose furosemide versus high-dose furosemide plus low-dose isosorbide dinitrate in severe pulmonary oedema. Lancet 1998; 351:389–393. This study helped define the relative role of two agents that had become the mainstay of therapy for acute pulmonary oedema and had theoretical risks and benefits at different doses. In the study, 110 patients with acute pulmonary oedema presenting with oxygen saturations below 90% received high-flow oxygen, IV frusemide 40 mg and morphine 3 mg. They were randomised to receive either isosorbide mononitrate (3 mg IV every five minutes) or IV frusemide (80 mg boluses every 15 minutes) plus isosorbide mononitrate (1 mg/hour). Low-dose frusemide and high-dose nitrates were more effective in terms of reducing the need for mechanical ventilation and the frequency of myocardial infarction.

Non-invasive ventilation improves mortality in hypercapnoeic patients with exacerbations of COPD.

Non-invasive ventilation has been investigated for a number of acute respiratory conditions, although its role in COPD has been established for the longest time.

- Plant P, Owen J, Elliott M. Early use of non-invasive ventilation for acute exacerbations of chronic obstructive pulmonary disease on general respiratory wards: a multicentre randomized controlled trial. Lancet 2000; 355:1931–1935. This multi-centre randomised controlled study involved 236 patients with acute hypercapnoeic exacerbations of COPD with mild to moderate respiratory acidosis. There was a reduced need for intubation and lower in-hospital mortality in the group who received non-invasive ventilation on a respiratory ward.

A subsequent Cochrane review of studies performed in and out of ICU settings also confirmed these benefits:

- Ram F, Picot J, Lightowler J, Wedzicha J. Non-invasive positive pressure ventilation for treatment of respiratory failure due to exacerbations of chronic obstructive pulmonary disease. Cochrane Database Syst Rev 2004: CD004104.

Low-molecular-weight heparin may safely replace unfractionated heparin for acute treatment of non-massive pulmonary embolism.

- Quinlan D, McQuillan A, Eikelboom J. Low-molecular-weight heparin compared with intravenous unfractionated heparin for treatment of pulmonary embolism: a meta-analysis of randomized, controlled trials. Ann Intern Med 2004; 140:175–183. This study analysed 12 trials involving 2,110 patients treated for symptomatic or asymptomatic non-massive pulmonary embolism. Compared with unfractionated heparin, low-molecular-weight heparin was associated with a non-statistically significant decrease in recurrent symptomatic venous thromboembolism at the end of treatment and at three months without a significant increase in bleeding complications.

Ultrasound should be used to guide internal jugular central venous line insertion.

- Hind D, Calvert N, McWilliams R et al. Ultrasonic locating devices for central venous cannulation: meta-analysis. BMJ 2003; 327:361–367. These authors analysed 18 trials involving 1,646 patients undergoing cannulation of their central veins. Successes and complications were compared in identified studies that randomised subjects to either the landmark method or real-time two-dimensional ultrasound guidance. In adults, the Doppler method was found to be more successful overall on the first attempt for the internal jugular vein, and had fewer complications.

It is becoming indefensible to obtain central venous access without ultrasonic guidance as recommendations for best practice strenuously advocate this technique.

Controversies and unanswered questions

> Education is the ability to listen to almost anything without losing your temper.
>
> *Robert Frost*

There will always be areas where controversy exists and/or debate continues regarding the most appropriate therapy. This section outlines some of the most topical questions and includes a guide to further reading.

ATLS

At the time of writing, the 8th edition of ATLS (Advanced Trauma Life Support) was in the process of being released in Australasia. In addition to the wealth of references contained in the manual, a number of significant changes have occurred that will be relevant to clinical practice. Some of these are addressed further in this section. Major changes in the content include:

- airway management — the LMA and bougie have been introduced as part of the difficult airway algorithm
- IV fluids — clinical equipoise is acknowledged for Ringer's lactate, normal saline and hypertonic saline in trauma resuscitation
- pelvic fractures — angiography for embolisation has been added to the management algorithm for unstable pelvic fracture
- thoracotomy is now recommended instead of pericardiocentesis for suspected pericardiac tamponade
- monitoring lactate and/or pH is now recommended for evidence of restoration of adequate perfusion with fluid resuscitation
- CT head rules have been introduced (see below)
- a clear statement has been included that steroids are of *no* proven benefit in spinal cord injury (see below)
- battlefield resuscitation is (C)ABC, recognising the importance of controlling exanguinating haemorrhage if you are present at the time of the injury; this is still in keeping with the ATLS principle of treating 'greatest threat to life first', as exanguinating haemorrhage can be fatal in less than a minute, whereas airway obstruction will not be fatal for a few minutes.
- use of a tourniquet for exanguinating haemorrhage has been introduced (without strong evidence for support but recognising current practice).

Interested readers may access further information regarding these most recent changes from **http://web15.facs.org/atls_cr/atls_8thEdition_Update.cfm**.

Should steroids be given to patients with traumatic spinal cord injuries?

Throughout the 1990s the use of steroids for traumatic spinal cord injury evolved from the NASCIS studies:

- Bracken M, Shepard M, Collins W et al. A randomized, controlled trial of methylprednisolone or naloxone in the treatment of acute spinal-cord injury. Results of the Second National Acute Spinal Cord Injury Study. N Engl J Med 1990; 322:1405–1411.
- Bracken M, Shepard M, Holford T et al. Administration of methylprednisolone for 24 or 48 hours or tirilazad mesylate for 48 hours in the treatment of acute spinal cord injury. Results of the Third National Acute Spinal Cord Injury Randomized Controlled Trial. National Acute Spinal Cord Injury Study. JAMA 1997; 277:1597–1604.

Major concerns have been raised about this paper and a general trend is away from the administration of methylprednisolone for acute spinal cord injury as the functional recovery purported to be associated with steroids lacks clinical significance:

- Hurlbert R, Hamilton M. Methylprednisolone for acute spinal cord injury: five-year practice reversal. Can J Neurol Sci 2008; 35:41–45.

Is hypertonic saline the fluid of choice for patients with traumatic brain injury?

- Cooper D, Myles P, Mcdermott F et al. Pre-hospital hypertonic saline resuscitation of patients with hypotension and severe traumatic brain injury: a randomized controlled trial. JAMA 2004; 291:1350–1357. This randomised controlled trial evaluated pre-hospital hypertonic saline (250 mL 7.5% saline compared with 250 mL Ringer's lactate) for pre-hospital resuscitation of 229 patients with traumatic brain injury and hypotension. There was no difference in neurologic function six months after the injury. Further studies using alternative regimens need exploration. Ongoing studies are underway to evaluate the role of hypertonic saline in different situations and conditions, as theoretical benefits are evident.

What is the role for recombinant factor VIIa in ED patients?

Off-label use of this expensive drug is being explored widely in trauma patients with a possibility of it being cost-effective by virtue of a reduction in blood products transfused. For example:

- Stein D, Dutton R, Hess J, Scalea T. Low-dose recombinant factor VIIa for trauma patients with coagulopathy. Injury 2008; 39:1054–1061.

The utility of this agent in intracranial haemorrhage remains unclear. Although it reduces haematoma size in patients with spontaneous intracranial haemorrhage, it does not appear associated with improvements in functional outcomes:

- Mayer S, Brun N, Begtrup K et al. Efficacy and safety of recombinant activated factor VII for acute intracerebral hemorrhage. NEJM 2008; 358:2127–2137.

Novoseven may have a potential benefit for traumatic intracranial bleeding but ongoing studies are necessary:

- Narayan R, Maas A, Marshall L et al. Recombinant factor VIIa in traumatic intracerebral hemorrhage: results of a dose-escalation clinical trial. Neurosurgery 2008; 62:776–786.

Is hypotensive resuscitation appropriate for some trauma patients?

- Bickell W, Wall M, Pepe P et al. Immediate versus delayed fluid resuscitation for hypotensive patients with penetrating torso injuries. N Engl J Med 1994; 331:1105–1109. This study involving 289 patients showed improved outcomes for

hypotensive patients with penetrating torso injuries who had delayed aggressive fluid resuscitation until operative intervention. A number of methodological issues have created substantial debate regarding the significance and applicability of these findings.

Debate has continued to address the role of hypotensive resuscitation in broader trauma cohorts. Of note, different algorithms for fluid resuscitation are now suggested in the Advanced Trauma Life Support (ATLS), Prehospital Trauma Life Support (PHTLS) and Battlefield Advanced Trauma Life Support (BATLS) protocols, depending on individual circumstances. Concerns must be explored regarding the appropriateness of hypotensive resuscitation in patients with traumatic brain injury where even transient hypotension has been associated with adverse effects on neurologic outcome. Some of these issues are addressed in a recent paper:

- Sapsford W. Should the 'C' in 'ABCDE' be altered to reflect the trend towards hypotensive resuscitation? Scand J Surg 2008; 97:4–11.

What is the best method for reducing anterior shoulder dislocations?

- Ashton H, Hassan Z. Best evidence topic report. Kocher's or Milch's technique for reduction of anterior shoulder dislocations. Emerg Med J 2006; 23:570–571. Despite the fact that anterior shoulder dislocation is a common condition managed in EDs, there remains a paucity of evidence concerning the most effective method for reduction. Numerous techniques have been described and individual physician preference appears to be the major basis for choice.

Is needle aspiration a safe and effective treatment of a primary spontaneous pneumothorax?

- Zehtabchi S, Rios C. Management of emergency department patients with primary spontaneous pneumothorax: needle aspiration or tube thoracostomy? Ann Emerg Med 2008; 51:91–100. This recent small meta-analysis, which included only three modest trials, suggests needle aspiration is at least as safe and effective as tube thoracostomy for management of primary spontaneous pneumothorax and is associated with fewer hospital admissions and reduced length of hospital stay.

What is the influence of BLS and ALS by paramedics on outcome in traumatic and non-traumatic conditions?

A large amount of research material has been developed by the OPALS (Ontario Prehospital Advanced Life Support) study group. This group analysed the before and after-effects of introducing BLS and then ALS in a system-wide fashion in the province of Ontario. Publications continue to be produced from this work.

- Stiell IG, Wells GA, DeMaio VJ et al. Modifiable factors associated with improved cardiac arrest survival in a multicenter basic life support/defibrillation system: OPALS Study Phase I results. Ontario Prehospital Advanced Life Support. Ann Emerg Med 1999 Jan; 33(1):44–50. Stiell IG, Wells GA, Field BJ et al. Improved out-of-hospital cardiac arrest survival through the inexpensive optimization of an existing defibrillation program: OPALS Study Phase II. Ontario Prehospital Advanced Life Support. JAMA 1999 Apr 7; 281(13):1175–1181. Some of the outcomes, particularly with regard to BLS, were in keeping with expectations, such as three- to fourfold increases in survival with bystander CPR and similar improvements when defibrillation was delivered within eight minutes of collapse. However, the introduction of public access defibrillation (PAD) had no effect on survival from cardiac arrest in the community. Given the marked improvement in survival from early defibrillation, the lack of influence from a PAD program was surprising. Subsequent analysis suggests placement of defibrillators may be

the issue: PAD would be used approximately once every three years in casinos but only every 246 years in schools (where the political push is for them to be placed).

The really interesting results are seen following introduction of ALS skills (Phase III). Perhaps surprisingly, the effect on survival from cardiac arrest was an insignificant rise (5.0% to 5.1%).

- Stiell IG, Nesbitt LP, Pickett W et al. OPALS Study Group. The OPALS Major Trauma Study: impact of advanced life-support on survival and morbidity. CMAJ 2008 Apr 22; 178(9):1141–1152. Overall survival did not differ between the groups provided ALS and BLS. However, among patients with a GCS less than 9, survival was *lower* among those in the ALS phase (50.9% vs 60.0%; $p = 0.02$). The effect of field intubation in particular was striking, with a 2.4 times increase in odds ratio of death.
- Stiell IG, Spaite DW, Field B et al. OPALS Study Group. Advanced life support for out-of-hospital respiratory distress. N Engl J Med 2007 May 24; 356(21):2156–2164. A range of additional ALS skills were introduced, including endotracheal intubation, IV drug administration, nebulised salbutamol and sublingual nitroglycerine for the relief of symptoms. The rate of death among all patients decreased significantly, from 14.3% to 12.4% (absolute difference, 1.9%; 95% CI, 0.4 to 3.4; $p = 0.01$) from the BLS phase to the ALS phase (adjusted odds ratio, 1.3; 95% CI, 1.1 to 1.5). The surprising thing in this study is that when procedures were examined, increased survival was seen for patients attended by ALS-trained paramedics, even if they did not use those skills.

Is chest compression alone better than full CPR in cardiac arrest?

The concept of chest compression alone for cardiac arrest instead of 'standard' CPR has attracted increasing interest in recent times. A number of papers have demonstrated equivalent or even superior outcomes. Combined with cooling, metabolic control and early reperfusion, this style of management has come to be known as 'cardiocerebral resuscitation'.

- Ewy GA. Cardiocerebral resuscitation: the new cardiopulmonary resuscitation. Circulation 2005 Apr 26; 111(16):2134–2142.
- Kellum MJ, Kennedy KW, Ewy GA. Cardiocerebral resuscitation improves survival of patients with out-of-hospital cardiac arrest. Am J Med 2006; 119(4):335–340.
- Kellum MJ. Compression-only cardio-pulmonary resuscitation for bystanders and first responders. Curr Opin Crit Care 2007 Jun; 13(3):268–272.
- Kellum MJ, Kennedy KW, Barney R et al. Cardiocerebral resuscitation improves neurologically intact survival of patients with out-of-hospital cardiac arrest. Ann Emerg Med 2008 Sep; 52(3):244–252. Epub 2008 Mar 28.
- Ewy GA. Cardiocerebral resuscitation: a better approach to cardiac arrest. Curr Opin Cardiol 2008 Nov; 23(6):579–584.

While it is clear that any form of resuscitation is better than none and that untrained bystanders can not only perform chest compressions alone with minimal prompting, but they also seem more willing to do this than full CPR, further research is required to validate this approach. If proven successful, this may revolutionise the way we do BLS.

How should red-back spider (RBS) antivenom be administered?

- Isbister GK, Brown SG, Miller M et al. A randomised controlled trial of intramuscular vs intravenous antivenom for latrodectism — the RAVE study. QJM 2008 Jul; 101(7):557–565. Epub 2008 Apr 8. These authors are rapidly amassing excellent quality research data on spider and snake bites from well-constructed,

multi-centre trials. The RAVE study was intended to resolve the issue of which mode of administration was best for RBS envenomation, measuring both venom and antivenom levels. Of particular interest was the statistical methodology adopted — a Bayesian analysis including past studies and based on 'stopping rules' derived from a previous survey of FACEMs to determine what level of difference was considered significant enough to change practice.

- Brown SG, Isbister GK, Stokes B. Route of administration of red back spider bite antivenom: determining clinician beliefs to facilitate Bayesian analysis of a clinical trial. Emerg Med Australas 2007 Oct; 19(5):458–463. The results were intriguing. No significant difference was observed between the treatment arms and hence support is provided for clinicians to continue their current practice by whichever route of administration they prefer. However, antivenom levels were not detected following IM administration. This raises the incredible possibility that the effect may be purely placebo — or perhaps the active agent in the antivenom is not what we are measuring. This will surely be an area of ongoing research.

How much antivenom is needed for brown snake envenomation?

Management of brown snake (and other snake) envenomation creates unique challenges for FACEMs in Australia. Much debate has been undertaken regarding the amount and type of antivenom required. Some studies have suggested as many as 10 vials should be administered as an initial dose for severe envenomation.

- Yeung JM, Little M, Murray LM et al. Antivenom dosing in 35 patients with severe brown snake (Pseudonaja) envenoming in Western Australia over ten years. Med J Aust 2004 Dec 6–20; 181(11–12):703–705.

More recently, this practice has been questioned. A number of the same researchers involved in RAVE have also collaborated in the Australian Snakebite Project (ASP):

- Isbister GK, Williams V, Brown SG et al. Australian Snakebite Project (ASP) Investigators. Clinically applicable laboratory end-points for treating snakebite coagulopathy. Pathology 2006 Dec; 38(6):568–572.
- Isbister GK, O'Leary MA, Schneider JJ et al. ASP Investigators. Efficacy of antivenom against the procoagulant effect of Australian brown snake (Pseudonaja sp.) venom: in vivo and in vitro studies. Toxicon 2007 Jan; 49(1):57–67. Epub 2006 Sep 17.

In a similar pattern to the RAVE study, venom levels were measured following snake bites. Calculations from the full range of clinical presentations (severe envenomation to no antivenom required) confirmed that a single vial of brown snake antivenom is sufficient to neutralise all the venom from severe envenomation. However, it takes a number of hours for clotting factors to regenerate before coagulation studies return to normal. On reflection, it seems that the *time* taken to administer large amounts of antivenom was more important than the antivenom itself. Further research is now looking at the use of Fresh Frozen Plasma (FFP) after antivenom administration.

Does octreotide successfully decrease acute bleeding from oesophageal varices?

- Corley D, Cello J, Adkisson W, Ko W, Kerlikowske K. Octreotide for acute esophageal variceal bleeding: a meta-analysis. Gastroenterology 2001; 120:946–954. This meta-analysis included the results of 13 somewhat heterogeneous studies involving 1,077 patients, most of which included fewer than 100 patients and many of which compared octreotide to another therapy (e.g. terlipressin, vasopressin) rather than a placebo. It was concluded that octreotide is superior to other agents and is a safe and effective adjunctive therapy with variceal obliteration techniques.

Should hyperbaric oxygen (HBO) therapy be used to treat patients with carbon monoxide poisoning?

- Wolf S, Lavonas M, Sloan E, Jagoda M. Clinical policy: critical issues in the management of adult patients presenting to the emergency department with acute carbon monoxide poisoning. Ann Emerg Med 2008; 51:138–152. This recent clinical policy from the American College of Emergency Physicians concluded that although HBO is a therapeutic option for poisoned patients, its use cannot be mandated because evidence is conflicting and no clinical variables, including CO levels, identify a subgroup of poisoned patients most likely to experience benefit, if one exists.

A key Australian contribution to the world debate was provided in the form of evidence against the use of HBO:

- Scheinkestel C, Bailey M, Myles P et al. Hyperbaric or normobaric oxygen for acute carbon monoxide poisoning: a randomised controlled clinical trial. Med J Aust 1999; 170:203–210.

Do hospital medical emergency teams (METs) improve the outcomes of critically ill patients?

Emergency physicians may be involved in managing cardiac arrest or MET calls. It is commonly believed that METs should replace cardiac arrest teams for rapid identification and treatment of patients before they deteriorate. Activation criteria for MET calls have included acute derangements in physiologic parameters as well as non-specific marked concern by staff members. Evidence supporting METs has been mixed.

- *For:* Buist M, Moore G, Bernard S, Waxman B, Anderson J, Nguyen T. Effects of a medical emergency team on reduction of incidence of and mortality from unexpected cardiac arrests in hospital: preliminary study. BMJ 2002; 324:387–390. This single-centre before and after study demonstrated a significant reduction in the incidence of and mortality from unexpected cardiac arrest.
- *Against:* Hillman K, Chen J, Cretikos M et al. Introduction of the medical emergency team (MET) system: a cluster-randomised controlled trial. Lancet 2005; 365:2091–2097. This cluster randomised study involving 23 Australian hospitals showed that MET increases emergency team calling but does not substantially affect the incidence of cardiac arrest, unplanned ICU admissions or unexpected death.

Should EDs have a protocol regarding N-AC for prophylaxis against radiocontrast nephropathy?

- Tepel M, van der Giet M, Schwarzfeld C, Laufer U, Liermann D, Zidek W. Prevention of radiocontrast agent induced reductions in renal function by acetylcysteine. N Engl J Med 2000; 343:180–184. This article, despite involving only 83 patients, generated major interest and utilisation of N-acetyl cysteine (N-AC), as it demonstrated a protective effect on serum creatinine. Interestingly, no difference in the need for interventions such as dialysis was demonstrated with N-AC.
- Chong E, Zed P. N-acetylcysteine for radiocontrast-induced nephropathy: potential role in the emergency department? CJEM 2004; 6:253–258. This systematic review failed to demonstrate a consistent benefit of N-AC, and more effective approaches in ED are likely to include ensuring adequate hydration and using lower volumes of less toxic radiocontrast.

Should thrombolysis be administered to patients with sub-massive PE?

Massive PE with shock has a high mortality and current recommendations are for aggressive treatment with thrombolysis, surgery or a percutaneous mechanical intervention. Thrombolysis may be considered in patients who experience a cardiac arrest with a high probability of PE as the cause. The situation for sub-massive PE with right ventricular dysfunction and normal blood pressure is less clear. The situation has been reviewed recently:

- Konstantinides S. Massive pulmonary embolism: what level of aggression? Semin Respir Crit Care Med 2008; 29:47–55.

Is there a role for levosimendan in ED?

Despite recent enthusiasm for this new inotrope in patients with acute decompensation of chronic heart failure (LIDO), recent evidence concludes that levosimendan does not improve the survival of this patient group:

- Delaney A, Bradford C, McCaffrey J, Bagshaw S, Lee R. Is there a place for levosimendan in the intensive care unit? Crit Care Resusc 2007; 9:290–292.
- Follath F, Cleland J, Just H et al. Efficacy and safety of intravenous levosimendan compared with dobutamine in severe low-output heart failure (the LIDO study): a randomised double-blind trial. Lancet 2002; 360:196–202.

Is there a role for new 'point-of-care' tests such as brain natriuretic peptide (BNP) and procalcitonin in ED?

Procalcitonin is being explored in a number of ED patient cohorts to investigate its possible role as a diagnostic and/or prognostic marker in febrile paediatric and adult patients, but definitive studies are necessary. For example:

- Hausfater P, Juillien G, Madonna-Py B, Haroche J, Bernard M, Riou B. Serum procalcitonin measurement as diagnostic and prognostic marker in febrile adult patients presenting to the emergency department. Crit Care 2007; 11:R60.
- Maniaci V, Dauber A, Weiss S, Nylen E, Becker K, Bachur R. Procalcitonin in young febrile infants for the detection of serious bacterial infections. Pediatrics 2008; 122:701–710.

Some authors support the use of BNP to increase the accuracy of the initial clinical impression regarding diagnosis of cardiac failure, as well as to improve patient disposition decisions:

- Peacock W, Mueller C, Disomma S, Maisel A. Emergency department perspectives on B-type natriuretic peptide utility. Congest Heart Fail. 2008; 14:17–20.

Should all patients with bacterial meningitis be treated with high-dose steroids?

The neurological outcome of bacterial meningitis is related to the severity of the inflammatory process incited by the pathogen in the subarachnoid space. Improved neurological outcomes (particularly reduced risk of sensorineural deafness) from bacterial meningitis have clearly been demonstrated in children given corticosteroids before the first dose of IV antibiotic is administered. Presumably harmful subarachnoid inflammation from the breakdown products of bacteriolysis is reduced by corticosteroids.

The evidence for benefit from corticosteroids in adults with bacterial meningitis is less certain. In van de Beek's meta-analysis, 18 studies involving 2,750 patients were analysed. Adjuvant steroids were associated with lower mortality, reduced rates of severe hearing loss and long-term neurologic sequelae. In children the most significant effects were on preventing hearing loss and in adults the most significant effects were

greater protection from death. With steroids, mortality reduction was most noticeable in patients with *Streptococcus pneumoniae* meningitis. Children with *Haemophilus influenzae* meningitis experienced the least risk of hearing loss:

- Van de Beek D, de Gans J, McIntyre P, Prasad K. Corticosteroids for acute bacterial meningitis. Cochrane Database Syst Rev 2007; CD004405.

In the most recent large adult study the regimen was dexamethasone 10 mg before or with the first dose of antibiotic, followed by 10 mg q6h for four days:

- De Gans J, van de Beek D; European Dexamethasone in Adulthood Bacterial Meningitis Study Investigators. Dexamethasone in adults with bacterial meningitis. N Engl J Med 2002; 347:1549–1556.

Concerns must remain about the wisdom of this regimen in patients who develop severe sepsis and septic shock, because high-dose steroids have been associated with increased mortality and even the use of low-dose steroids for 'relative adrenal insufficiency' remains highly contentious. The use of steroids in children in the era of HIB vaccination and in meningococcal sepsis is uncertain.

Is lactulose an important component of supportive treatment for patients with decompensated liver failure?

- Wright G, Jalan R. Management of hepatic encephalopathy in patients with cirrhosis. Best Pract Res Clin Gastroenterol 2007; 21:95–110. While lactulose is commonly prescribed for patients with hepatic encephalopathy, more reliable randomised placebo-controlled trials supporting its role in liver failure are lacking.

Evidence-based practice recommendations

Life support

The most recent ILCOR guidelines on ACLS in adults and paediatrics (2005) can be found in:

- The International Liaison Committee on Resuscitation (ILCOR) Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiac Care Science with Treatment Recommendations. Resuscitation 2005; 67:157–342 or **www.ilcor.org**.
- Australian Resuscitation Council (ARC) Guidelines. Emerg Med Australas 2006; 18:322–371 with editorial on 317–321.
- New Zealand Resuscitation Council (NZRC): **www.nzrc.org.nz**.

Sepsis

- Surviving Sepsis Campaign: international guidelines for management of severe sepsis and septic shock: 2008. Crit Care Med 2008; 36:296–327. [Erratum, Crit Care Med 2008; 36:1394–1396.]

Acute coronary syndromes

- National Heart Foundation of Australia/Cardiac Society of Australia and New Zealand. Guidelines for the management of acute coronary syndromes 2006. Med J Aust 2006; 184:S1–S29.
- Joint American Heart Association/American College of Cardiology statements and guidelines: **www.americanheart.org**.

Heart failure

- Task Force on Acute Heart Failure of the European Society of Cardiology. Executive summary of the guidelines on the diagnosis and treatment of acute heart failure. Eur Heart J 2005; 26:384–416.

Anticoagulation reversal

- Warfarin reversal: consensus guidelines, on behalf of the Australian Society of Thrombosis and Haemostasis. MJA 2004; 181:492–497.

Stroke prevention in non-valvular AF

- Hankey G. Non-valvular atrial fibrillation and stroke prevention. On behalf of the National Blood Pressure Advisory Committee of the National Heart Foundation. MJA 2001; 174:234–239.

Traumatic brain injury

- Brain Trauma Foundation Guidelines: Guidelines for Prehospital Management of Severe Traumatic Brain Injury, 2nd edition; Guidelines for the Management of Severe Traumatic Brain Injury, 3rd edition: **www.braintrauma.org**.

Asthma

- National Asthma Council of Australia. Asthma Management Handbook 2006: **www.nationalasthma.org.au**.

Other topics

- A range of useful guidelines are provided by the British Thoracic Society: **www.brit-thoracic.org.uk**.
- The UK's National Institute for Health and Clinical Excellence (NICE) has a range of evidence-based reviews available: **www.nice.org.uk**.
- The Cochrane collaboration has many useful reviews available: **www.cochrane.org**.

Key points

- Time spent understanding basic statistics and EBM is a lifelong investment.
- Understanding how to evaluate the medical literature that influences clinical practice is a useful core skill for emergency physicians.
- Become familiar with the evidence underpinning the practice of emergency medicine and understand that this is of varying quality.
- Try to develop your own 'evidence base' that supports the key management strategies for all of the conditions commonly encountered in emergency departments.

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Glossary of common statistical terms

absolute risk difference The absolute difference in the incidence of an outcome in two groups. For example, an incidence of 10% in group A and 15% in group B would be described as group B having a 5% higher absolute risk for the outcome.

allocation concealment In intervention studies, this requires the investigator and patient to be deliberately kept unaware of which treatment arm the patient will be entered into until they consent to participation.

bias Systematic errors in design, conduct or analysis of a trial or selective inclusion or exclusion of studies in a meta-analysis, leading to inaccurate outcome estimates for interventions.

blinding After allocation in intervention studies, the patient, clinician and outcome assessor should not know what treatment the patient is assigned to as this may lead to biased outcome assessment.

hypothesis or significance testing The most common hypothesis tested is the 'null hypothesis', i.e. that there is no difference between groups (e.g. non-inferiority trial). Alternatively, the hypothesis may be that a treatment improves outcome (superiority trial). The statistical analysis then generates the probability (*p*-value) that the result has occurred by chance alone. A threshold *p*-value of 0.05 (5% probability the difference is due to chance alone) is conventionally accepted as statistically significant and hence this threshold is used to reject or accept the hypothesis.

intention to treat (ITT) analysis Patients in intervention studies should be analysed in the group to which they are randomised regardless of compliance, in order to reduce the risk of biased results or interpretation. It simulates real life with variable treatment compliance.

meta-analysis The systematic review and evaluation of data from two or more individual studies.

negative predictive value The proportion of patients with a negative test result who really do not have the disease.

95% confidence interval Reflecting the uncertainty of an observed study result, this confidence interval is expected to contain the true population result with 95% probability.

number needed to harm The number of patients needed to be given treatment in order to produce one adverse outcome.

number needed to treat The number of patients needed to be given treatment in order to produce one favourable outcome.

odds ratio The ratio of patients with or without an assessed outcome in each group.

per protocol analysis Includes only comparisons between patients who receive the treatment allocated to them, and so is biased. Per protocol analysis accurately quantifies the true effect of treatment when administered as intended.

positive predictive value The proportion of patients with a positive test result who really do have the disease.

power (of the study) The probability that a study will detect a truly existing difference between groups.

***p*-value** The probability that the difference observed between groups in a study is a chance finding. Statistical significance is usually determined as a *p*-value of less than 5% ($p < 0.05$).

randomisation Process whereby recruited patients have an equal, quantifiable but random chance of being allocated to either the experimental or control treatment in intervention studies. If performed well, any detected difference is likely to be due to treatment effect rather than between-study group imbalance.

relative risk difference The ratio of the incidence of an outcome in two groups. For example, an incidence of 10% in group A and 15% in group B would be described as group B having a 50% higher relative risk for the outcome.

sensitivity The proportion of patients with disease who also have a positive test. Sensitivity reflects how well the test identifies patients with disease.

specificity The proportion of patients without disease who have a negative test. Specificity indicates how well the test identifies patients without disease.

study group equivalence Apart from the study treatment allocation, all study subjects should be treated equally in terms of the frequency and timing of follow-up, investigations carried out to assess outcome or adverse effects, and receipt of co-treatment.

type I error (α) When a difference is observed between groups when there is no real difference, i.e. the difference is a result of chance alone. The probability of this occurring is the same as the significance level set for the *p*-value, i.e. typically 5%.

type II error (β) When there is a real difference between two groups but it is not observed in the results. The incidence of a type II error is generally unknown but reduces as sample size is increased.

Glossary of terms used in the fellowship examination

assessment History taking, physical examination and investigations.
describe State the characteristics or appearance of the subject, including *relevant negatives*.
discuss Examine the pros and cons of each of the alternatives asked for on a subject.
disposition Where the patient is sent following care in the emergency department, including follow-up if discharged.
interpret State a conclusion or conclusions, which includes a differential diagnosis.
investigations Specific tests undertaken to make a diagnosis or monitor the patient's condition.
list A numerical ordering of related items.
management Those aspects of care of the patient encompassing treatment, supportive care and disposition.
outline A brief description of the subject.
protocol A set of instructions on how to deal with a particular situation.
treatment Measures undertaken to cure or stabilise the patient's condition.

Source: www.acem.org.au, October 2008.

Index

Page references followed by 'f' denote figures; those followed by 't' denote tables